THIS ISSUE IS IN TWO PARTS—PART I

MARCH 1961

Heating Piping & Air Conditioning

ENGINEERING DATA FILE

Thermoplastic Piping: What it is — What it does — How to use it
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. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings

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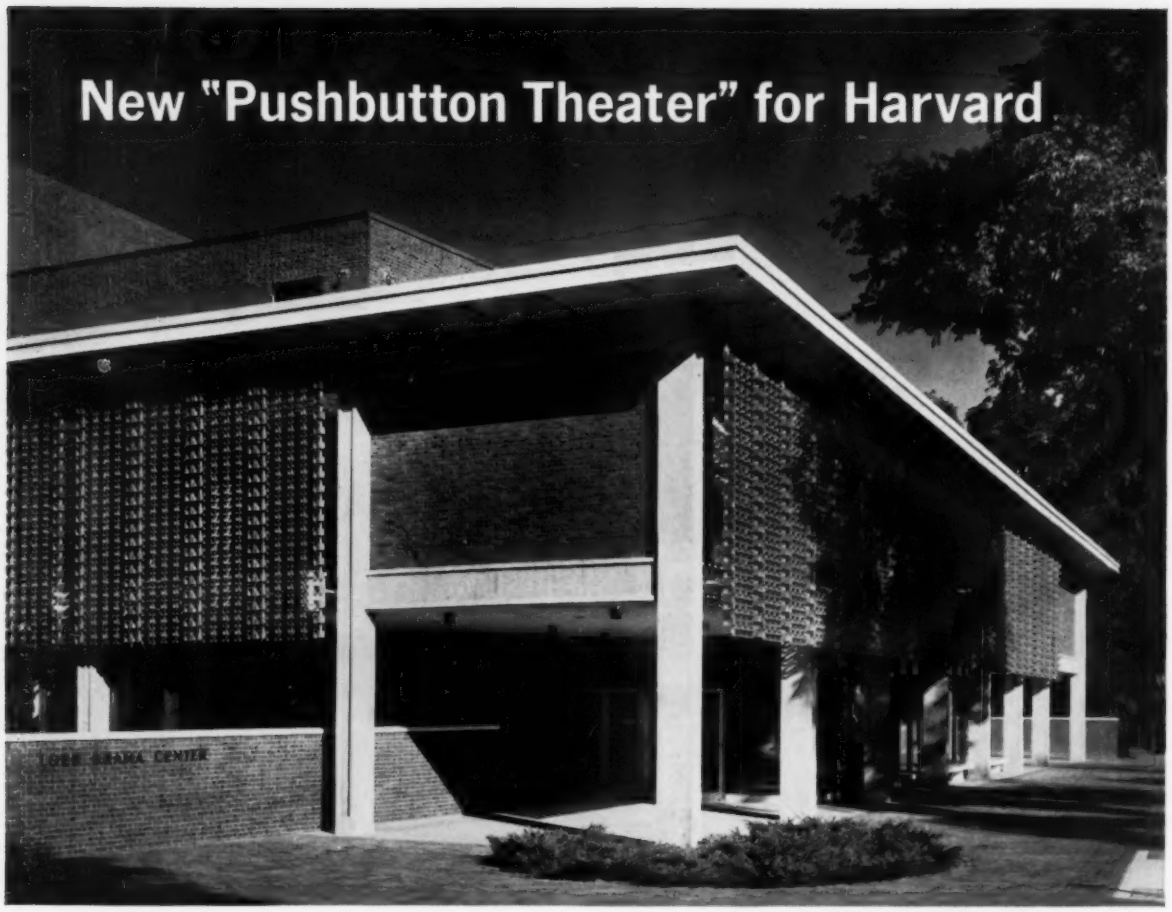
Vacuum Return Cures Hospital's Steam Heating Ills . . . page 95

Good Procedures Forestall Corrosion In Hot Water Heating Systems . . . page 115

New "Pushbutton Theater" for Harvard



LOEB DRAMA CENTER, Harvard University, Cambridge, Mass.

Architect: HUGH A. STUBBINS & ASSOCIATES, CAMBRIDGE, MASS. *Plumbing & Heating Engineer:* DELBROOK ENGINEERING, INC., CAMBRIDGE, MASS. *General Contractor:* GEORGE A. FULLER CO., NEW YORK, N. Y. *Plumbing & Sprinkler Contractor:* C. H. CRONIN, INC., BOSTON, MASS. *Heating, Ventilating & Air Conditioning Contractor:* THOMAS G. GALLAGHER, INC., SOMERVILLE, MASS.

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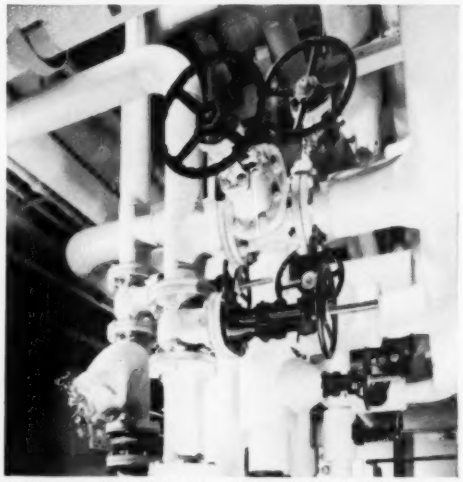

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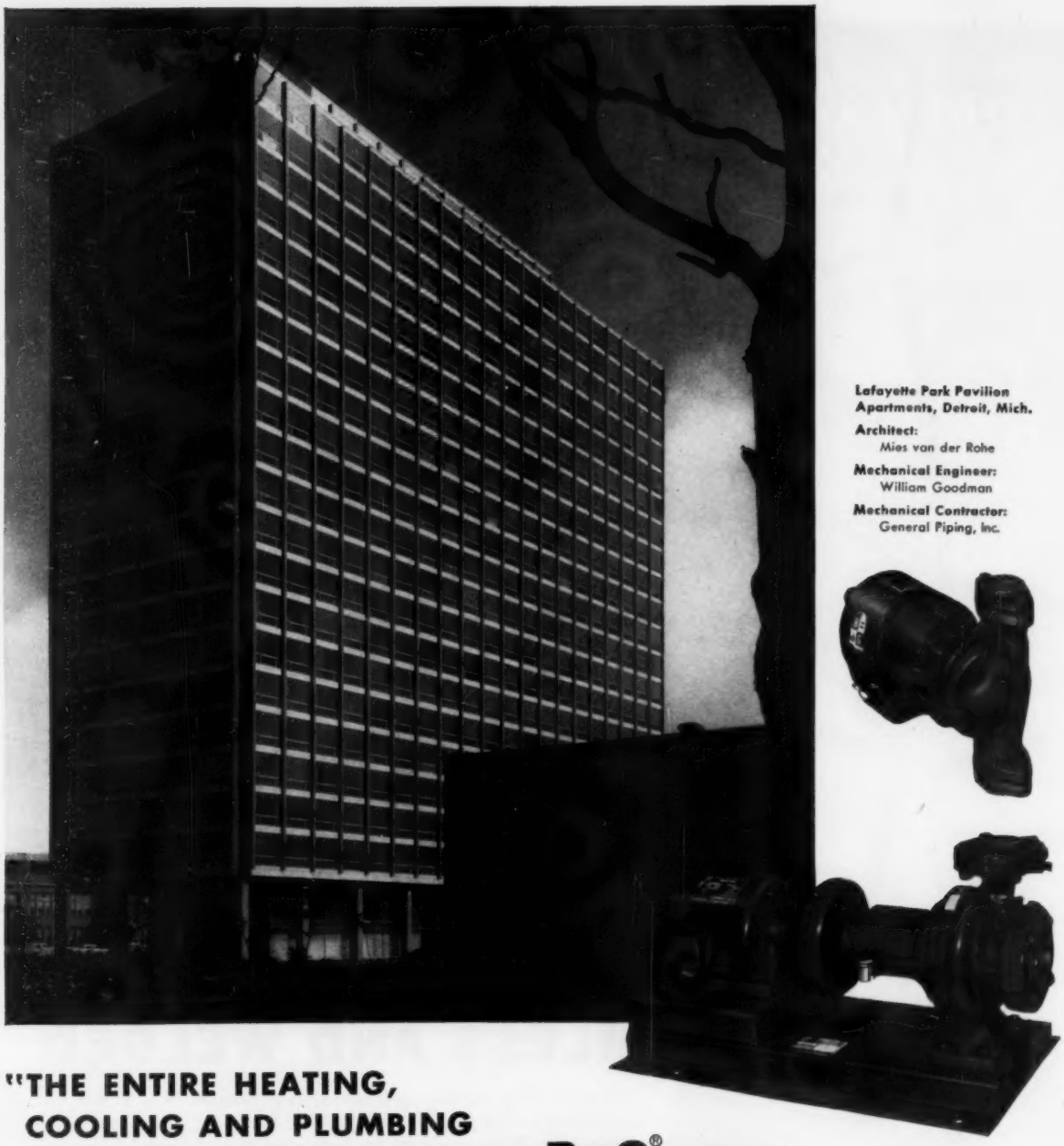

Lafayette Park Pavilion Apartments, Detroit, Mich.

Architect:
Mies van der Rohe

Mechanical Engineer:
William Goodman

Mechanical Contractor:
General Piping, Inc.

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Heating, Piping & Air Conditioning

FOR CONSULTING ENGINEERS, MECHANICAL (HEATING, PIPING, AND AIR CONDITIONING) CONTRACTORS, ENGINEERS WITH PLANTS AND BIG BUILDINGS

VOL. 33, NO. 3 MARCH 1961

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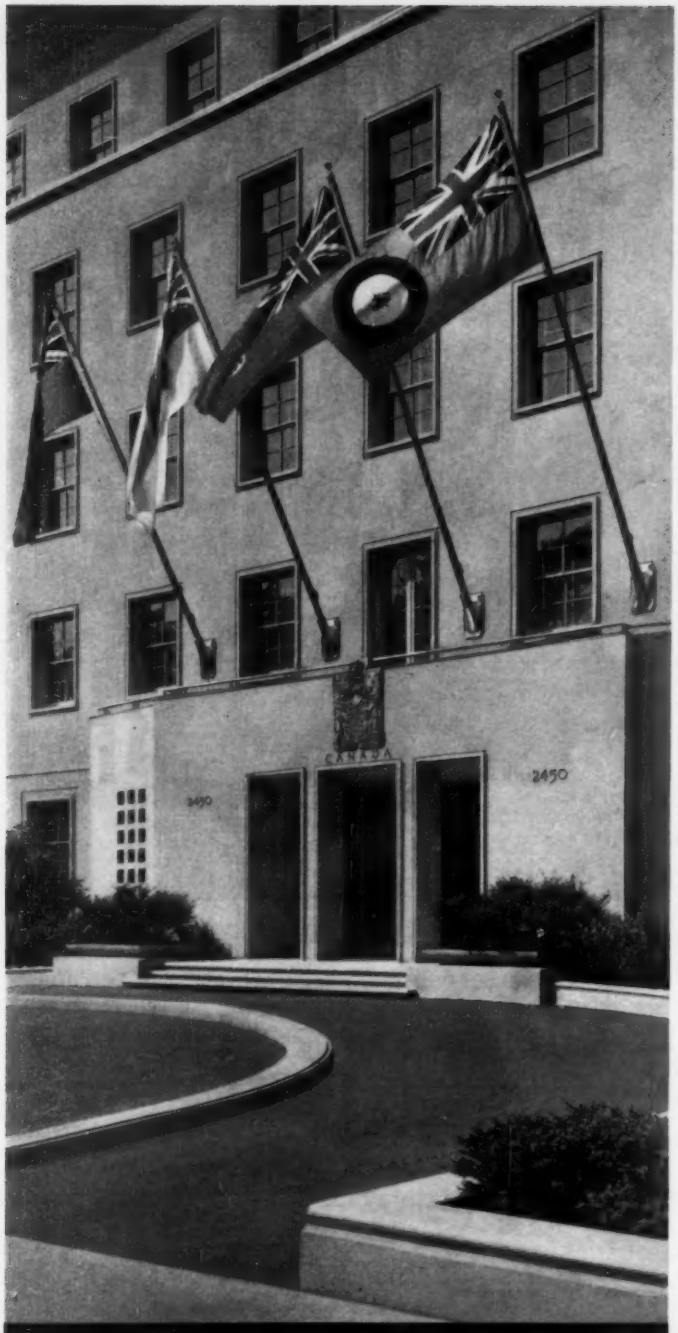

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Consulting Engineer:
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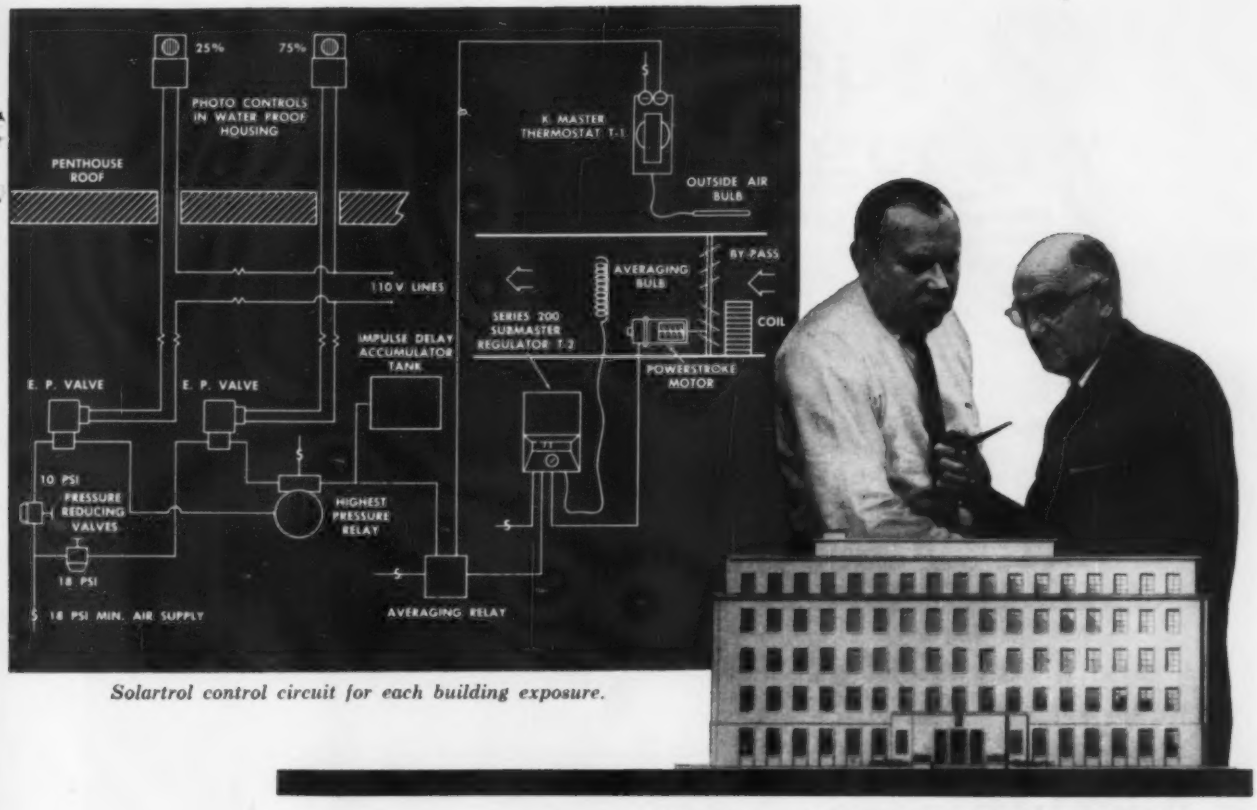
Consulting Engineer, Charles S. Leopold, confirmed his reputation for imaginative engineering when he put the sun to work in the air conditioning system of the Canadian Joint Staff Building, Washington, D. C. As a result, the occupants enjoy year-round comfort.

The Powers SOLARTOL, an electronic-pneumatic system designed to measure solar intensity and regulate air conditioning systems accordingly, is used to accomplish this.



Solartrol control circuit for each building exposure.

G. Titus Fenn, chief designer, and Charles S. Leopold.

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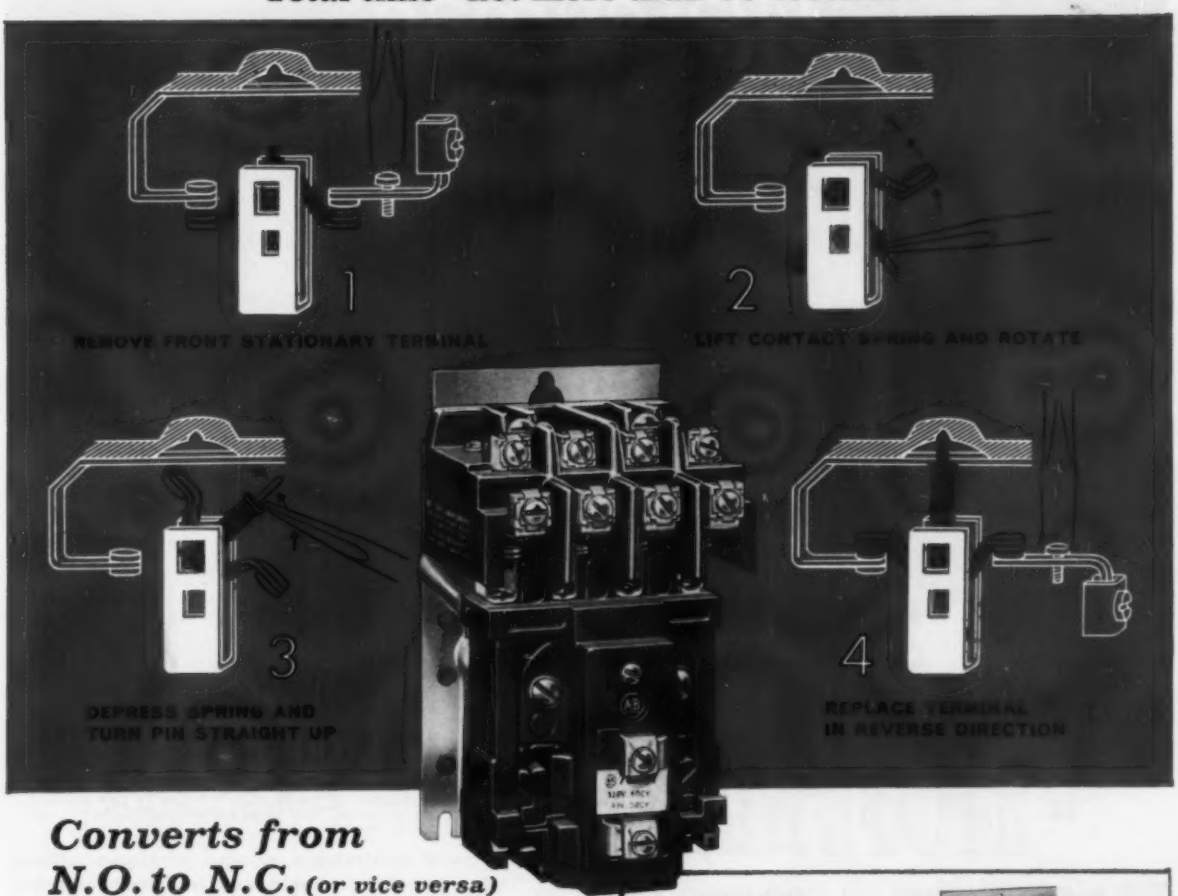

Converts from N.O. to N.C. (or vice versa) in 60 SECONDS!

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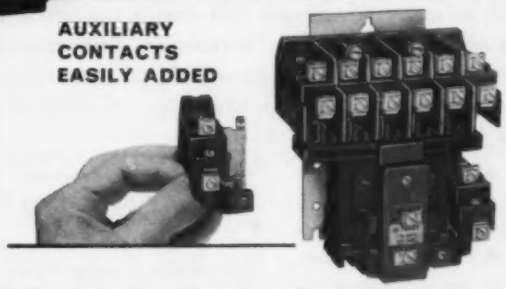

Type BR relays are available with 2, 3, 4, or 6 poles—but as a valuable bonus, one or two fully rated poles can be added to the base of each relay—even in the field. It's a simple addition that takes only moments.

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LETTER FROM THE EDITOR

March 1961

Dear Reader:

The article beginning on page 91 is about the design of a specialized air conditioning system that is really unique. This system was designed especially for an extra high voltage laboratory to permit testing of cables where the environment must be precisely controlled including the relative humidity at 40 percent or less. Lewis Smith is the author, and in this article he discusses the design features of the heating and air conditioning systems and many interesting installation details. With the growing importance of research and the construction of laboratories this article is certainly worthy of your consideration.

How a hospital steam heating system was made more efficient is explained by Edward Hoffman on page 95. Prior to applying the corrective measures, condensate remained in the radiators and return lines which in turn forced a quick drain on the steam supply when automatic zone control valves opened. The cure for this problem was in the installation of an impulse type vacuum receiver for the condensate return system. This has not only made the system operate as it should perform, but it has also drastically reduced the steam requirements.

The new district heating and cooling system in Hartford, Connecticut to serve seven buildings and a shopping center through a 14,000 ft underground pipeline undoubtedly has many advantages that are worthy of your consideration. The article on pages 97 to 99 explains these as well as some of the problems that may be encountered in the design of these systems.

For safe operation of compressed gas piping systems, Ellis L. Stout has compiled some vital rules that should be followed. His article is on page 100 and in it are contained some valuable tables of properties of many gases which will be helpful in designing these piping systems.

Five views are given in the article on page 104 as to how to best coordinate improved lighting and air conditioning techniques for the modern office buildings of today. The lighting specialist said at today's lighting standards of 100 foot-candles per sq ft, it is imperative that the design of the air conditioning system consider this heat input and design the air distribution systems to provide the best comfort. Samuel R. Lewis, speaking for the consulting engineer's viewpoint, related how his firm has designed a number of installations with these requirements in mind. The illumination engineer discussed the importance of the higher foot-candle levels and how important the ceiling is in the proper planning and design of these systems. The architect stated that he may wish to have some of the ceiling returned to him for more integrated design of all the services contained in the ceiling. The user urged that more emphasis be placed on maintenance during the design phases.

LETTER FROM THE EDITOR (continued) --

A method of determining operating costs for two types of power for large air conditioning systems is given by Victor Chun in his article on page 108. He suggests that a combination of an absorption machine and steam turbine driven centrifugal chiller be considered in evaluating the methods available to achieve the desired cooling effect. In an example he shows that this combination can save appreciable operating costs.

The design of the heating and air conditioning systems for the new home office center of Union Oil Co. in Los Angeles required the careful consideration of not only climate, sun load, but location of the buildings to achieve the most workable solution. Lester Ries discusses these engineering design problems and the solutions that resulted in using a high velocity dual-duct system in his article on page 110. This article certainly illustrates how architects and mechanical engineers can combine forces to develop an installation that coordinates all that is desirable for a satisfactory solution.

How to prevent corrosion in hot water heating systems is discussed by R. H. Hayman in his article on page 115. He suggests that all hot water heating systems should be cleaned prior to start-up in order to eliminate debris which may interfere with the heat transfer rate and which may accelerate corrosion. Various solutions available for later chemical treatment of circulating water are also suggested as a means of insuring satisfactory protection against corrosion.

Two interesting case histories from a consulting engineer's files are reported by C. T. Baker on pages 122 to 124. He cites the case of the low bidder and the case of the fractured pump casing in this article.

Sam Lewis reports some interesting experiences with dampers this month on page 124.

A valuable check-list for sheet metal duct design is presented as the Data Sheet on pages 125 and 126. This check-list has been prepared by the Ventilating and Air Conditioning Contractors Association of Chicago and this should be very helpful to the consulting engineer particularly in designing duct systems and in preparing the ventilating specifications. The check-list is to be used in conjunction with the new "Manual of Duct Construction for Ventilating and Air Conditioning Systems" which has been issued by the Sheet Metal and Air Conditioning Contractors National Association.

Don Bahnfleth, HPAC Engineering Editor, has prepared a comprehensive report on the subject of plastic piping which begins on page 127 this month. In order to be able to design these piping systems for dependable operation, knowledge of the properties and design limitations should be understood. This information has been included as well as a discussion of good installation procedures that should be followed. This information has been compiled from many sources and should be very useful as a reference.

Do you agree with the answers given on pages 82 and 84 to the question about using No. 6 fuel oil where constant modulation is required?

The many news items and other short reports on pages 37 to 40 in the You'll What to Know section will help keep you informed.

Part 2 of this issue is another Trade Literature Supplement prepared for your convenience in obtaining copies of new bulletins with a minimum effort on your part. I hope you will find it to be helpful.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

NEW

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The new Chicago DPA pump is an exceedingly sturdy, quiet unit providing maximum hydraulic efficiency at all times. Suction, discharge openings and bearing housings are integrally cast into the lower case for maximum rigidity and perfect alignment.

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Contractors . . . Lehigh Engineering Company, Bethlehem, Pa. And the owners, H. Ted Lyons and G. W. Hersh, Jr., agree . . . "Acme was selected as the most economical and efficient to both heat and cool the entire project. We're proud and pleased with the operation of all the Acme equipment installed. Maintenance and service calls have been at a minimum and our customer has never had anything but praise for the job."

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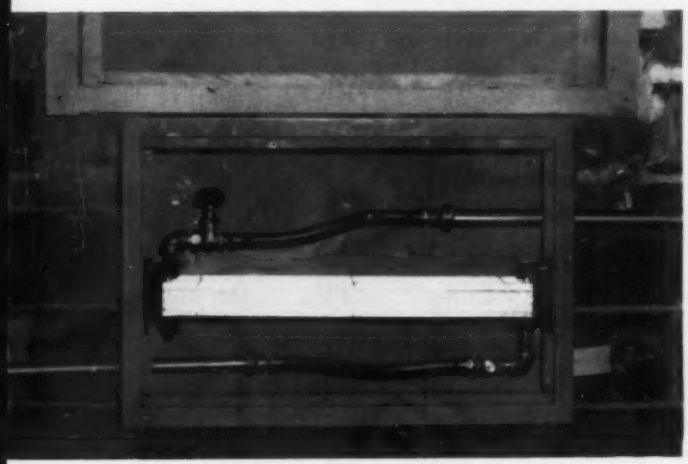
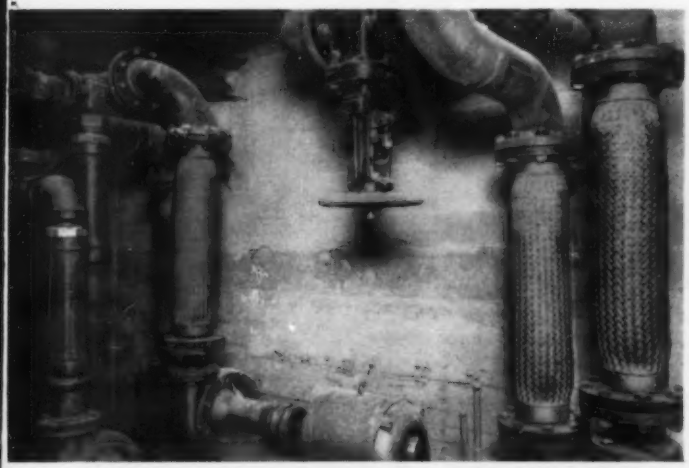
APPLICATION HINTS:

Ways to simplify construction and cut costs with Flexpipe

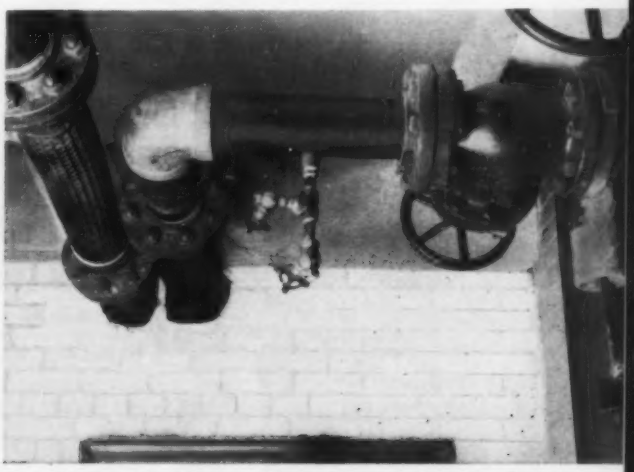


Cut total piping costs of heating systems. Flexpipe connectors handle offset and riser expansion—eliminate the need for extreme accuracy in roughing-in—eliminate time and cost of through-floor connections, hung ceilings and furred out walls. Piping can hug the wall, saving floor space. Flexpipes are used to simplify design and installation in both steam and hot water heating systems.

Save space, absorb vibration, cut installation time in air conditioning systems. In larger heating and cooling systems, Flexpipes take up movement caused by expansion and contraction in piping—absorb vibration from pumps—require less space—install easily in tight quarters—even when outlets do not line up—cut costs of using short lengths of pipe and elbows.



Handle expansion on long horizontal runs in big hot water jobs. Modern schools and institutions of multi-structure design involve long horizontal runs for hot water heating mains. Using Flexpipes to take up expansion and contraction in the mains can often eliminate the need for expansion bends—make possible smaller, more economical tunnels—simplify and speed installation—reduce maintenance. Flexpipes also dampen pump vibration and minimize transmission of noise along the heating mains.



Meet big, tough piping problems. Flexpipes have the flexibility and strength to handle many unusual and complex jobs. These are available in sizes through 16" I.D. in tin bronze, stainless steel or hot-dipped galvanized steel. In the installation above, Flexpipes helped solve some difficult problems in air conditioning a large office building. Flexpipes connect risers and branch pipes, handle movement up to 2 inches in the spring-mounted risers, and water pressures up to 400 psi at lower floors.

WHERE TO BUY: Leading plumbing and heating supply houses can provide you with information about Flexpipe in standard sizes. For the name and address of the distributor serving your area, or for more detailed information, write to: Anaconda Metal Hose, P.O. Box 791, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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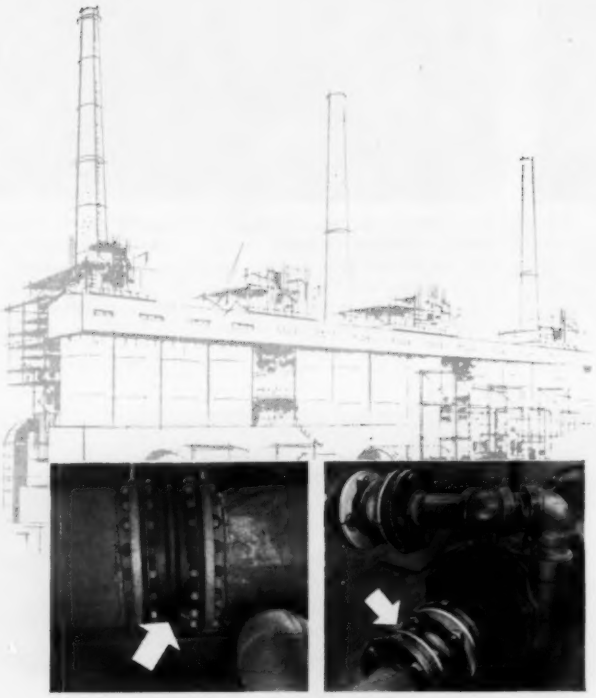
for Plant Maintenance



Typical installations show Garlock Rubber Expansion Joints on a 26" vacuum condenser inlet (left) and 2½" suction and discharge pipes. Garlock furnishes standard joints from ¾" to 72" in pipe diameter, and in all shapes.

Install Garlock Rubber Expansion Joints. It's good piping practice; here is why:

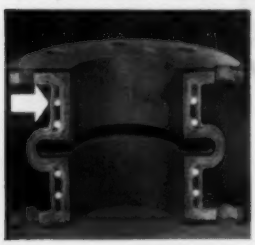
1. Prevent stresses. Piping systems expand and contract with temperature changes. Garlock Expansion Joints act as a "breather" . . . compensate for expansion and contraction.

2. Eliminate vibration and noise. Pumps, compressors, engines, and pressure surges in pipe lines create vibration and objectionable noises. Garlock Rubber Expansion Joints act as an absorbent cushion . . . reduce vibration and insulate against transfer of noise to other parts of the building.

3. Compensate for misalignment. Piping and mechanical equipment often move out of normal alignment during operation due to wear, load stresses, or settling of buildings. Garlock Rubber Expansion Joints compensate for this and prevent possible breakdowns of equipment. They also make installation easier since alignment of piping and equipment need not be as accurate when expansion joints are used.

4. Reduce flange breakage. Undue stress caused by misalignment, vibration, expansion or contraction of piping or equipment, will break the metal connecting flanges. Garlock Rubber Expansion Joints relieve such stresses.

Offer many application advantages. Garlock Rubber Expansion Joints outlive metal ones; do not crack, corrode, lose shape, or require gaskets. The sturdy construction of Garlock Rubber Expansion Joints results in satisfactory service where pressures are as high as 150 p.s.i., temperatures to 180°F.



Expansion joints are also available for service up to 450°F. In the photo of the joint cut in half, the arrow points to a steel reinforcing ring which, when varied in number with the joint size, provides the extra strength needed for the most severe applications.

For more data, call the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-137, Garlock Inc., Palmyra, N.Y.

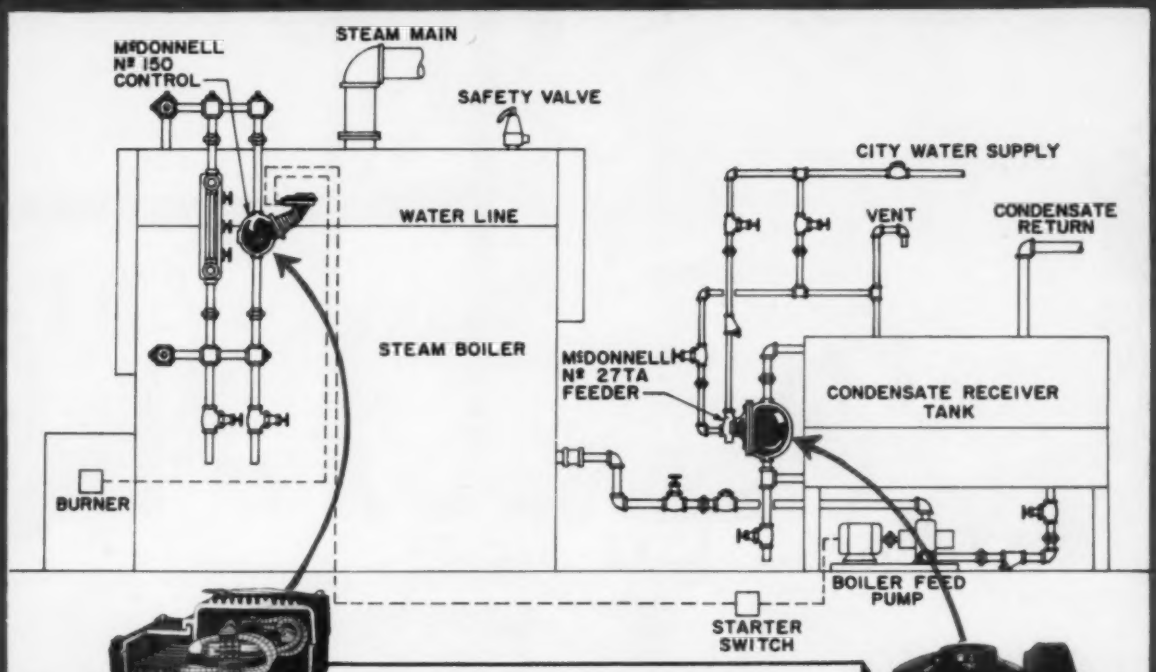
GARLOCK

Canadian Div.: Garlock of Canada Ltd.
Plastics Div.: United States Gasket Company.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*DuPont Trademark

The TWO BEST FRIENDS
any boiler ever had



THE PUMP CONTROL AND LOW WATER CUT-OFF:

McDONNELL No. 150

Used as pump control, low water fuel cut-off and low water alarm. Built in the McDonnell tradition to stand up under the temperatures and pressures such a control encounters. Underwriters' listed.

How to use them—

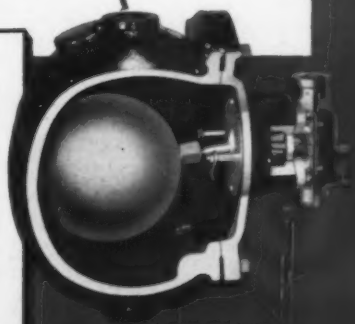
The drawing shows the simple hook-up that has solved the tough problem of water level control for medium pressure boilers... boilers with steam pressures up to 150 psi.

McDonnell No. 150 on the boiler controls the boiler feed pump as it should be controlled—directly *from* the boiler water level. This holds the water level within the close limits that assure maximum steaming efficiency and fuel economy.

McDonnell No. 27TA Water Feeder, installed on the receiver tank, adds the necessary make-up water as required by the system.

The low water cut-off and alarm in the No. 150 provides circuits for cutting off burner and sounding low water alarm—a final safeguard from emergency conditions such as current interruption in the pump circuit or failure of make-up water supply.

Yes, this is the most thoroughly proved, widely used hook-up of its kind, adaptable to every condition. McDonnell Water Level Controls are available for steam boilers up to 250 psi. and for hot water space heating boilers. *Write for information.*



THE MAKE-UP WATER FEEDER:

McDONNELL No. 27TA

A float-operated make-up water feeder with the large feeding capacity and sturdy construction essential to maintain the required water level in receiving tanks. Other types for all needs.

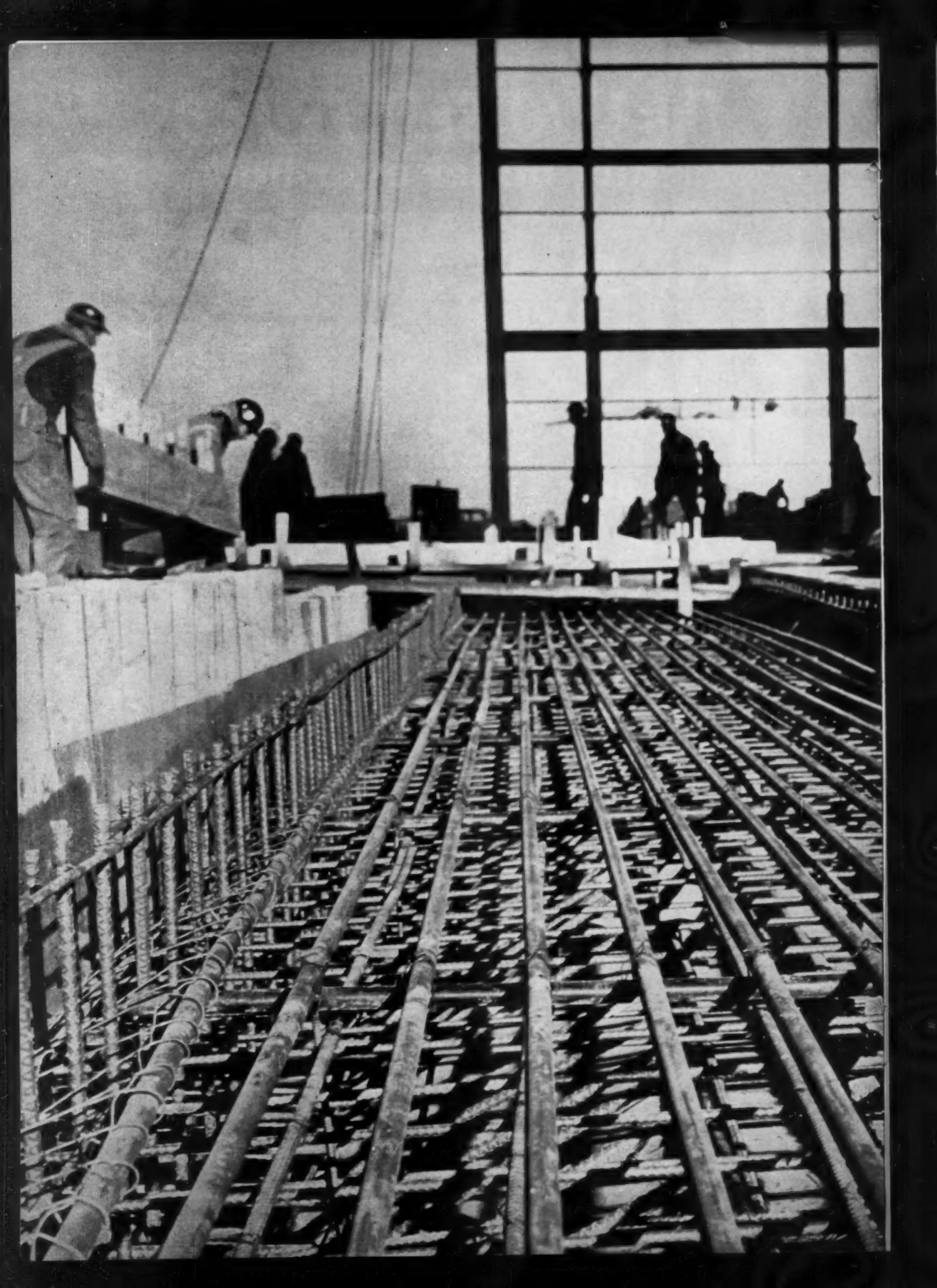
McDONNELL & MILLER, *Inc.*, 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

Your Jobber Stocks Them

McDONNELL *Boiler Water Level Controls*

BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • FLOW SWITCHES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS



BUILD

wherever, whatever you build, you'll build better with the full range of high quality steel pipe from Youngstown

Quality steel pipe from Youngstown mills is low-cost, efficient and long-lived. It carries steam to melt snow for Chicago's huge O'Hare Field. Brine to freeze a Des Moines, Iowa ice rink. Water and gas for housing. Heat lines in city skyscrapers. And it does a thousand other jobs.

Youngstown steel pipe is simple and easy to install using standard practices. Order it continuous weld or seamless. Get it black or galvanized, standard weight, extra strong, double extra strong, large O.D., reamed and drifted, threaded or plain end. Whichever you choose you know that you're getting quality that is controlled from ore to open hearth to mills to final inspection and delivery by Youngstown, world's second largest pipe producer.

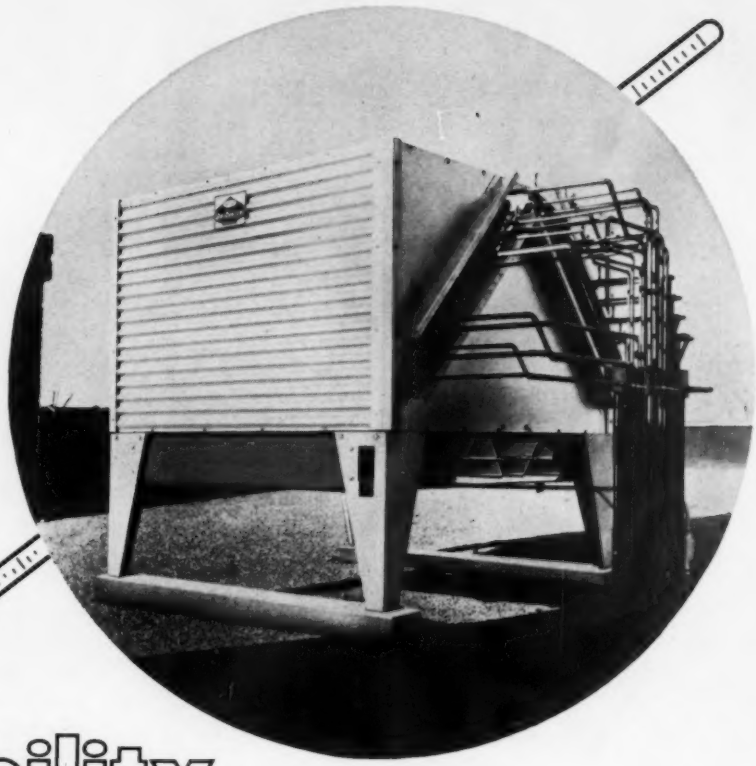
900 independent pipe distributors across the country are your reliable source for fast, on-site delivery of quality Youngstown pipe.

Next time you build, specify steel pipe you can depend on. Specify steel pipe for better building from Youngstown.

Youngstown – growing force in steel

For full details on Youngstown Standard Pipe, write to: Dept. D-31
The Youngstown Sheet and Tube Company, Youngstown, Ohio

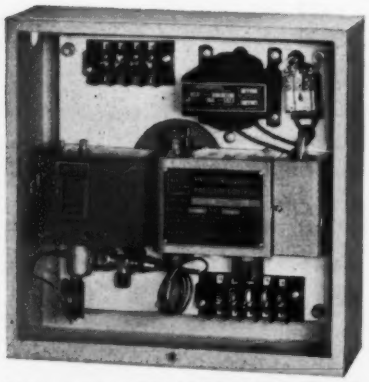
when the Dry Bulb goes down



controlability

stands out in Marley DriCooler®

AIR COOLED CONDENSERS



DIAL THE PRESSURE YOU WANT
DriCooler Damper Control does the rest. A single setting of this simple control maintains correct pressure regardless of dry bulb fluctuation.

Customer Certified

SIMPLY SUCCESSFUL—SUCCESSFULLY SIMPLE: that is a factual description of DriCooler Damper Control System. Design simplicity that eliminates pressure valves, by-pass piping and oversized receivers is basic in the Marley method that requires no coil flooding, no added refrigerant charge in low dry bulb periods.

DriCooler Damper Control System is pressure actuated and ignores dry bulb drops. By governing intake air and air flow, it maintains uniform condensing temperature during critical periods without adjustments. It is never necessary to out-guess the weather man.

DriCooler Damper Controls are building outstanding records of successful service in cities with widely varying dry bulb conditions, like Douglas, Arizona and Montreal, Quebec. Ask the Marley Man to show you facsimiles of certified recordings that show how DriCooler Damper Controls perform on single- or multi-circuit jobs.

U. S. and Foreign Patents Pending

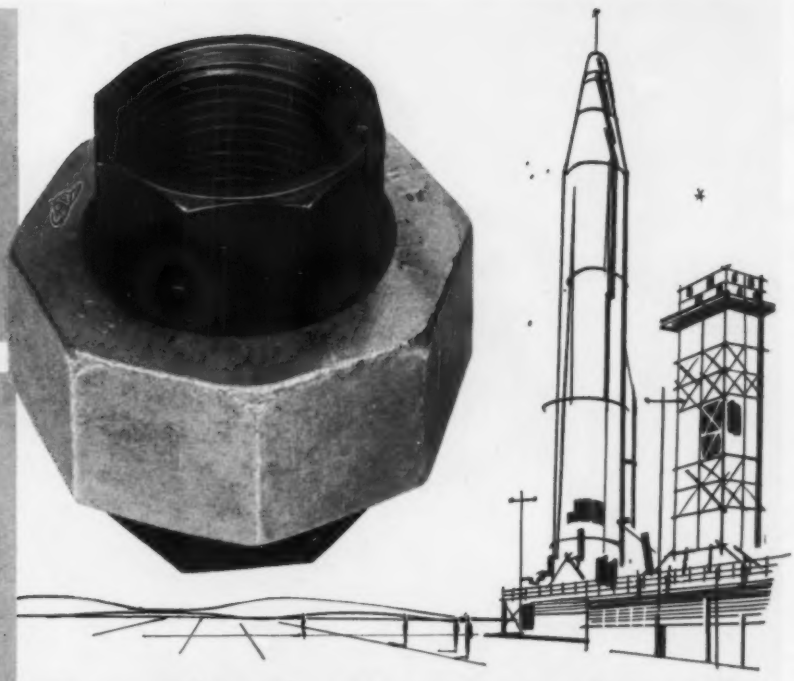
THE MARLEY COMPANY • KANSAS CITY 14, MISSOURI

4
EASY WRENCHING
FAST MAKE-UP

3
CLEAN/OVER-ALL PROTECTION

2
POSITIVE SEATING

1
LEAK-PROOF CONNECTIONS



Capitol count down

– INSURES NO FAILURES!

A union is more than a fitting. Installed, it is a refinery . . . a skyscraper . . . an atomic-energy plant! Continued operation depends on it.

And you can count on Capitol forged steel unions . . . because they give you 4-way service insurance.

(1) *Leak-proof connections* assured because Capitol unions have *more* threads, accurately cut and double-checked according to Army-Navy gauging practice. Both hand-tight and pressure-tight threads are checked, two operations instead of the one required for American Standard gauging. The extra threads mean on-the-job assurance of tight installations. (2) *Positive seating* because each union is individually pressure-tested. (3) *Clean/over-all protection*, each male and female part completely phosphate coated; each nut electro-zinc plated. (4) *Easy wrenching/faster make-up* because all three parts have a definite octagon shape.

You get all 4 important advantages at no extra cost when you specify CAPITOL forged steel unions . . . one of the full-line of Army-Navy gauged forged steel fittings. Now more than one million in service . . . and not a single failure.

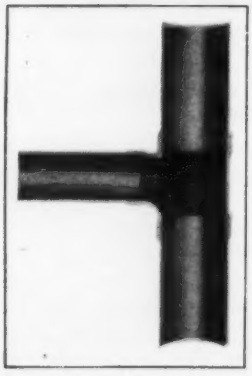
CAPITOL MANUFACTURING CO.,
Division of Harsco Corporation, Columbus, Ohio.

SPECIFY CAP FOR ALL FITTINGS

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS

CAPITOL

Unretouched photo of 3" dia. copper tube removed after 13 years' service in a soil line.



Anaconda drainage fittings are designed to match Anaconda tube for fast, easy solder connections.

WASTES FLOW FREELY IN COPPER DRAINAGE SYSTEMS AND YOU SAVE MONEY. Compare the condition on the inside of this copper tube with what you might expect to find in ordinary piping after 13 years in service. Rust-caused troubles such as reduced flow or stoppages do not occur inside copper drainage lines. That is why many plumbing codes allow the use of 3" diameter copper tube for soil line and vent. Material costs are reduced and, because a 3" copper tube stack with fittings fits inside a standard 4" partition, the need for expensive, space-consuming plumbing walls is eliminated. Save time, effort, and money—install the modern drainage system with Anaconda copper tube and fittings. For information, write: Anaconda American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

6001L

ANACONDA

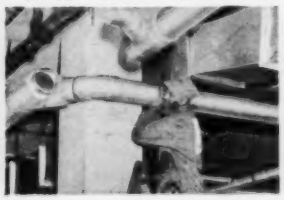
COPPER TUBE AND FITTINGS for soil, waste and vent lines

Available through plumbing wholesalers. Anaconda American Brass Company

Longer Lengths—Fewer Joints

Preassembly—Saves Time

Lightweight Copper—Easier Installation



Compact Connections—Save Space

WAGNER® MOTORS AT WORK

power to cool a clerical center

Two Wagner® 900 hp motors utilize easily accessible low voltage power to drive centrifugal compressors in New York's Interchurch Center

One of the newest office buildings in the city, the 19-story Interchurch Center houses more than 2,000 workers. It is completely air conditioned . . . all 400,000 square feet of it.

It's a big job, powering the centrifugal compressors in a system that is designed to air condition that much space. A job usually handled by high voltage motors, but done here by two 900 hp Wagner® Type RP open type motors rated at 460 volts, 1750 RPM. They were specified to take advantage of an easily accessible low voltage power supply, and so eliminate the expense of running in a high voltage line. How do they perform under loads created by centrifugal compressors? Simply put, they operate at peak efficiency, day in and day out.

Compact and dripproof, Wagner RP motors are packed with power and stamina. They're the perfect drives for big pumps, fans, and blowers as well as compressors. Built in frame sizes 504U through 962S, Wagner open type motors are available in ratings through 1000 horsepower.

Want your motor application analyzed? Call your Wagner Sales Engineer. His recommendations, and Wagner motors, will serve you well.

THE INTERCHURCH CENTER

Owner: The Interchurch Center

Architects:
Collens, Willis and Beckonert
Vorhees Walker Smith Smith & Haines

General Contractor:
Turner Construction Company

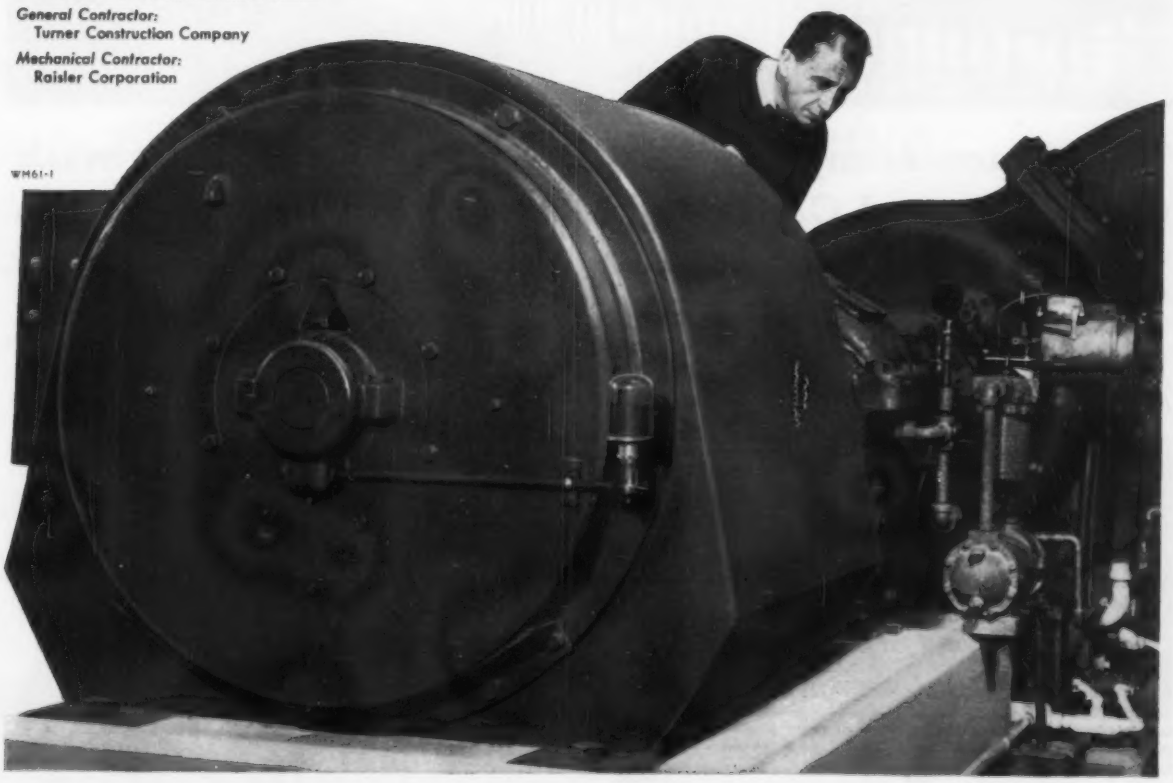
Mechanical Contractor:
Raisler Corporation

Branches and Distributors in all Principal Cities

Wagner Electric Corporation

6370 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

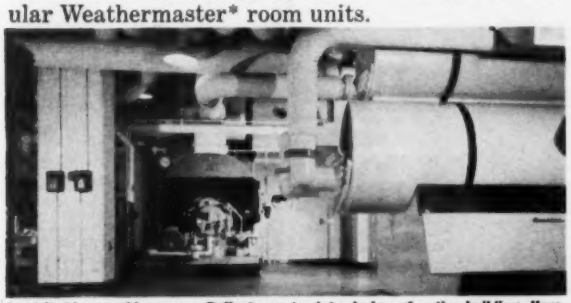
WM61-1



New headquarters of Home Security Life Insurance Co., Durham, North Carolina, completely air conditioned with Gas-operated Carrier Absorption Refrigeration. Associated architects: Small & Boaz; Antonin Raymond & L. L. Rado. Consulting engineers: General Engineering Associates. General contractor: George W. Kane. Mechanical contractor: W. H. Sullivan Co., Inc.

Insurance company insures comfort cooling with GAS-operated CARRIER Absorption Refrigeration

The attractive new home office of Home Security Life Insurance Company in Durham, North Carolina, is as modern in personnel comfort as in its design. It is completely air conditioned with one of the most efficient systems available – Gas-operated Carrier Absorption Refrigeration serving 190 Modular Weathermaster* room units.



Good-looking machine room. Reflects up-to-date design of entire building. Here the gas-operated Carrier unit operates at 250-ton capacity to cool 575 GPM water from 52.5 F to 42 F. when supplied with 12 psig steam.

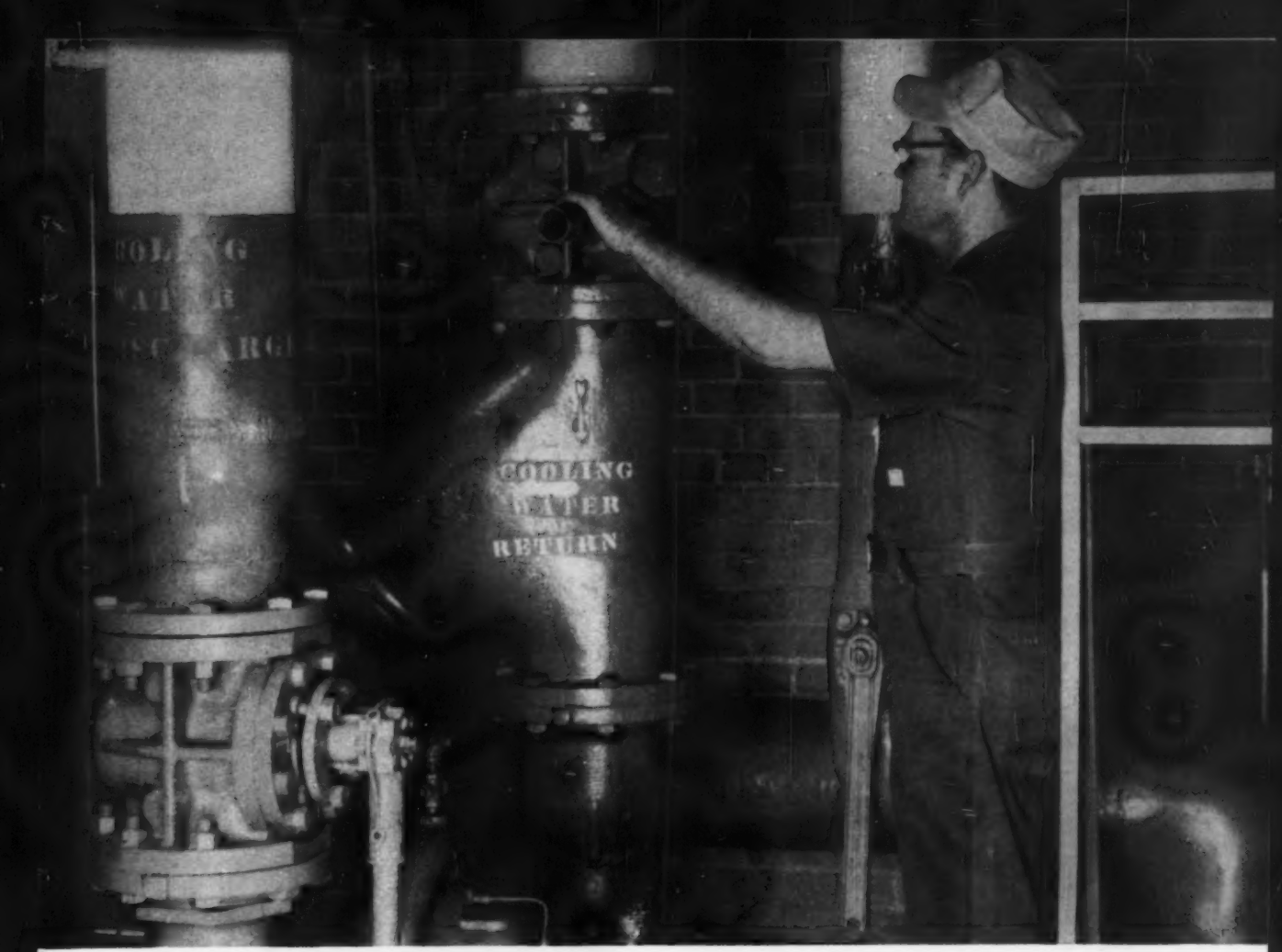
The Carrier absorption system is the essence of simplicity and economy. No prime mover is required. The energy source is low-pressure steam from a gas-fired boiler. Water is the cooling agent. Boiler capacity is put to use on a year 'round basis . . . cooling in summer, heating in winter. And thrifty gas keeps fuel costs low.

For comfort cooling at low cost, specify Gas and Carrier Absorption Refrigeration. Performance data and cost details are yours for the asking. Call your local Gas Company, or write Carrier Air Conditioning Company, Syracuse 1, New York.

American Gas Association.

FOR HEATING & COOLING GAS IS GOOD BUSINESS!

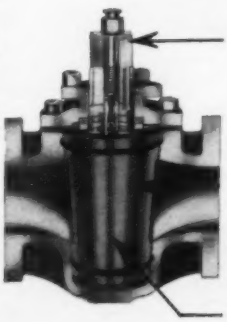
*Reg. U. S. Pat. Off.



HOW ONE VALVE GIVES POSITIVE SHUT-OFF AND PRECISE SYSTEM BALANCING

SIZES TO 36": Lines above 8" are no longer a problem. Specify sizes and pressure rating to meet your design needs.

COMPACT: No bonnet cavity or rising stem saves weight and space.



PERFECT BALANCE: Plug is smoothly, easily positioned for precise throttling . . . wrench shows degree of throttle.

THROTTLE or SHUT-OFF: If desired, shut-off valve can be eliminated downstream from throttle valve. Positive shut-off assured by pressurized lubricant.

NO CHANCE OF NOISE: Solid tapered plug is perfectly seated in rugged body . . . no exposed seats . . . silent for the life of the building.

More and more air conditioning design engineers are specifying Rockwell-Nordstrom lubricated plug valves to get *both* positive shut-off and precise balancing with one valve. Since these valves are positively sealed by pressurized lubricant and they are easily positioned to give just the right degree of throttle it is easy to see why they've been used on so many of the new chilled water systems. Additional, important benefits of Rockwell-Nordstrom valves: *compact design* (no yoke or bonnet) to fit in tightest areas . . . *quiet operation* because flow through the valve is smooth, easy . . . and *long life* because it's a lubricated mechanism.

Why not get complete details on Rockwell-Nordstrom, the world's most complete line of lubricated plug valves, lubricants and accessories. Send the coupon below. Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited. Rockwell International, S.A., Geneva, Switzerland.

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

Rockwell Manufacturing Company
Dept. 110C
Pittsburgh 8, Pa.

Please send Bulletin V-203.
Please have your representative call.

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DEKORON®
NEW POLY-COR

Dekoron products are first in the field for wide selection . . . quality . . . service . . . new product development. And the New Poly-Cor is the latest development to make instrument tubing news.

For here is a superb instrument line harness of exceptional quality with features never before available. Check them carefully. New grade of all-black polyethylene for operation at higher temperatures . . . number coding of tubes for easier hook-up . . . Mylar® vapor barrier . . . lighter weight. All these features are now standard in New Poly-Cor — and at no increase in price.

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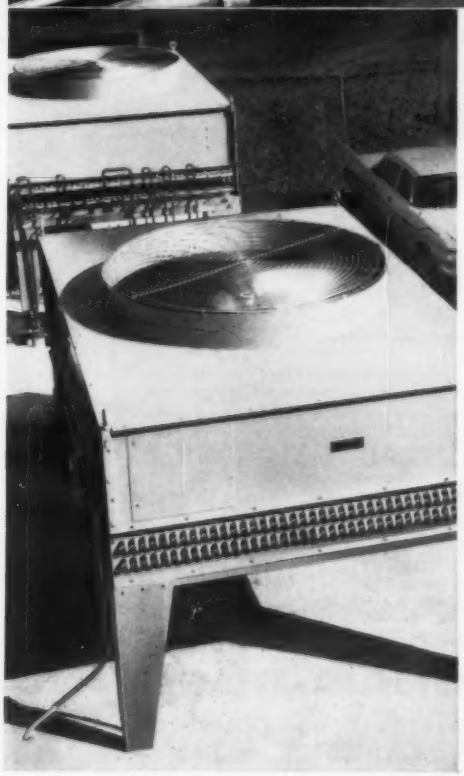
A-2318A

SAMUEL MOORE & COMPANY • DEKORON PRODUCTS DIVISION • **MANTUA, OHIO**

"Here's why I'm sticking with H&M air-cooled condensers



. . . H&M's Limitrol valve lets you use them year-round!"

"Many of my air conditioning and refrigeration systems have to operate 12 months a year. But cold weather used to raise cain with compressor-condenser balance.

"Then I learned that Halstead & Mitchell had a Limitrol pressure modulating valve that adjusts their air-cooled condenser capacity to compressor head pressure, whatever the outside temperature. What's more, H&M gives me multiple circuiting at no extra cost!"

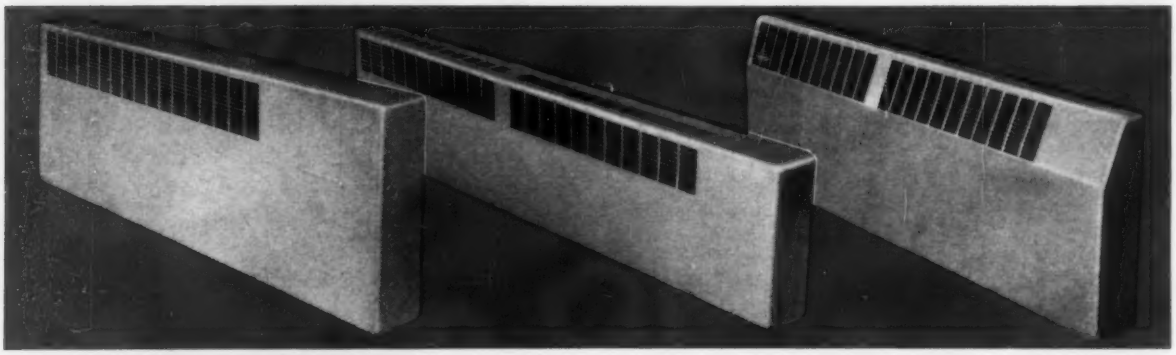
You'd do well, too, to standardize on H&M Air-Cooled Condensers. There are propeller fan models with vertical or horizontal air discharge, and centrifugal fan models for inside installation with ductwork. Capacities of 5 to 100 tons.

Want more information? Call your parts wholesaler or write for Bulletin AC-102. Halstead & Mitchell Co., Bessemer Building, Pittsburgh 22, Pa.

Air-Cooled Condensers • Air Handlers and Coils • Cooling Towers • Water-Cooled Condensers

HM Halstead & Mitchell

"Slide'n Snap" FIN VECTOR RADIATES DESIGN VERSATILITY



NOW... DUNHAM-BUSH OFFERS...

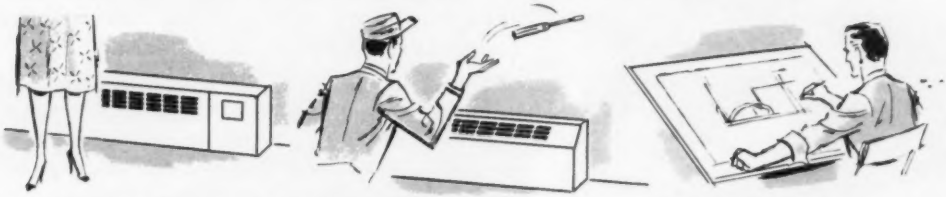
CHOICE OF...FRONT COVER...FRONT/TOP COVER...SLOPING COVER

Completely refashioned to architects' and contractors' specifications, Dunham-Bush Fin Vector full "wrap-around" cover in all three styles introduces exciting possibilities for heating industrial, commercial and institutional buildings.

The new Fin Vector flush mounts, 1, 2 or 3 tiers high. It fits wall-to-wall installation like a glove. Or, Fin Vector can be efficiently employed in separate units as convectors and combined with Dunham-Bush Unit Heaters, Heating-Cooling Units and Convectors . . . for any combination of requirements.

Heating element size selection is a cinch as Dunham-Bush supplies a full range in copper and steel. Ingenious ball-bearing hanger provides "floating action", minimizing noise, at no extra cost.

The new face and features of Fin Vector win quick approval of all concerned with heating . . .



Rounded Corners Complement Sleek Long-Low Design
Architecturally correct in all respects. Whatever the building construction or decoration, Fin Vector presents an attractive, continuous flowing appearance without overlap seams. Louvre design minimizes wall smudging.

Quick . . . Economical . . . Easy Lowest-cost Installation
The time-saving, money-saving secret is "Slide'nSnap" design and installation with a complete package of accessories. Even the hangers snap and lock at the selected proper pitch. No screws in the cover.

The Building Isn't Built That Poses a Problem for Fin Vector
Whether heating's for commercial, industrial or institutional buildings . . . whether room design is simple or complicated . . . whether heat demands are high or low . . . Fin Vector fits.

DUNHAM-BUSH

Send for complete specification details of Dunham-Bush "FC", "TFC" and "SC" Fin Vector Radiation. Request data sheets No. 1258C, No. 1271, No. 1272, No. 1273, and No. 1274.

DUNHAM-BUSH, INC.
WEST HARTFORD 10, CONNECTICUT, U. S. A.
SALES OFFICES LOCATED IN PRINCIPAL CITIES

NOW... get Relative Humidity readings directly with this portable *Taylor* recorder

New Taylor 100J Relative Humidity Recorder is actuated by Nylon Fibre elements that change in length with variations in moisture content. This physical change is magnified by a special mechanical linkage and used to actuate a pen which records humidity *directly* on an easy-to-read 24-hour chart. The two-pen instrument shown here also records dry bulb temperatures.

Why don't you take advantage of these many fine features:

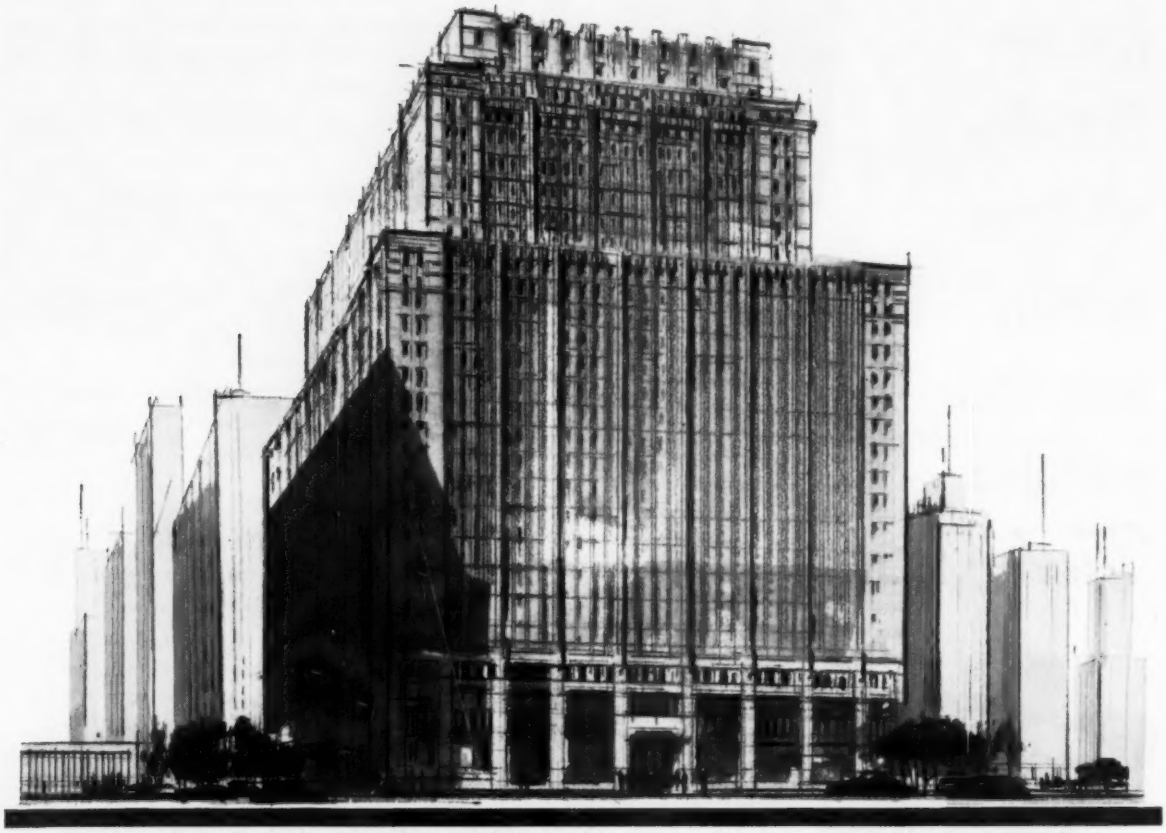
Easy to read. No conversions to make.
Portable. Weighs only twenty-five pounds. Handle is standard equipment.
Accuracy unaffected by periodic saturation.
No water supply connections. No troublesome wicks to change.
Dependable, trouble-free service . . . same mechanism as time-proven 76J Recorder.
Low cost . . . Shelf delivery.

. . .

Write now for **Bulletin No. 98410.** Taylor Instrument Companies, Rochester, New York, and Toronto, Ontario.

Taylor Instruments **MEAN ACCURACY FIRST**

Climate by Chrysler



2 Park Avenue, New York City. Consulting Engineers: Sears and Kopf; Mechanical Contractor: Kennedy-Scheidel-Young, Inc.; Electrical Contractor: Theodore Kalsh, Inc.

Chrysler Air Conditioning tailored to tenant needs installed a floor at a time in 27-story building

During the past five years, scores of Chrysler air conditioners have been installed at 2 Park Avenue, New York City. What has been one of the longest air conditioning jobs in history has also been one of the most successful.

By handling this 27-story building zone by zone and floor by floor, about 1400 tons of Chrysler equipment have been installed . . . with an absolute minimum of inconvenience to tenants. As tenants move in or renew leases, they are consulted as to exact air conditioning requirements. Each then gets the system best suited to his needs.

This unusual method is flexible—Chrysler can supply packaged units, chillers or room units as needs demand. And it is economical—all air conditioning equipment taps into central electrical, water and air connections which serve the entire building.

Chrysler engineers worked closely with the consulting engineer and contractor during the advance planning of this complex air conditioning problem. They will be as happy to cooperate with you. For information on their services and Chrysler Air Conditioning equipment, write today.

CHRYSLER AIRTEMP

In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario
Airtemp Division, Chrysler Corporation, Dept. CD-31, Dayton 1, Ohio

IN TUBING—Nothing Beats Copper!
IN COPPER—Nothing Beats
READING!

For

COPPER WATER TUBE

Specify

READING "*LEKTRONEAL*"®

Ideal in

- General Plumbing
- Heating Systems
- Drainage Waste and Vent Lines
- Sprinkler and Irrigation Systems
- Rural Installations

Features • Soft Temper Tubes Can Be Curved Around Corners and Obstructions and thru Small Openings, yet Are Rigid Enough to Keep from Sagging without Support.
• Solder Fittings Can Be Applied More Quickly, Easily, Conveniently.
• Cuts Installation Costs Substantially as Compared with Other Materials.
• Enduring • Bright Clean Finish
• High Heat Conductivity

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COPPER REFRIGERATION TUBE
Specify
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COMMERCIAL COPPER TUBE
(in Varied Shapes)
RED BRASS & COPPER PIPE
THREADLESS COPPER PIPE
COPPER DRAINAGE TUBE
Specify READING

For
SMALL, SEAMLESS PRECISION COPPER TUBE
Specify MACKENZIE WALTON
Product of MACKENZIE WALTON CORP.®

For
FINNED COPPER TUBE
Specify READI-FIN®
Product of READI-FIN MFG. CO., INC.®

READING COPPER BRASS TUBE
And RED BRASS PIPE

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A DIVISION OF PROGRESS MANUFACTURING CO., INC.
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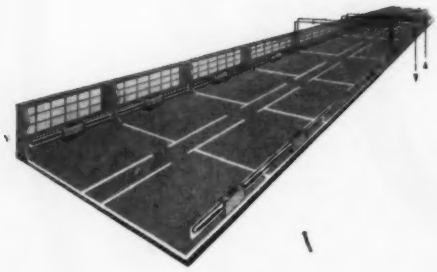
COMPLETELY INTEGRATED QUALITY CONTROL, FROM OUR OWN REFINERY TO OUR OWN DISTRIBUTION DEPOTS

The Nesbitt 600 Line

NEW... improved system for

classroom comfort and economy



Wind-o-line Radiation makes the difference!

This new engineering publication for the Series 600 Line is now ready. Write for a copy of Pub. 10A1.

Of course you like the beauty of modern lines and colors . . . and you welcome the fact that these new integrated storage cabinets provide the mobility and flexibility demanded by creative teachers . . . but of prime importance to *you*, as a designer for classroom thermal comfort, is the fact that the features and advantages of Wind-o-line Radiation have been retained in the new Nesbitt Series 600 Line.

Wind-o-line solves the cold downdraft problem . . . but more than that: In a forced hot water system the copper tubing of Wind-o-line finned radiation serves as the supply and return piping for the Syncretizer unit ventilators in a whole group of classrooms. Costly pipe trenches, conventional mains, run-outs and pipe coverings are eliminated.

Syncretizer multiple serpentine heating elements deliver the required heating capacity with water quantities a third or less of those demanded by conventional elements; and the additional heating surface provided by Wind-o-line further reduces the water quantity. Smaller pipes and pumps are used.

The gravity heating capacity of the Syncretizer with Wind-o-line radiation is more than sufficient to maintain adequate building temperatures during shutdown periods. Special controls and intermittent fan operation are unnecessary.

Thus, for daytime comfort, nighttime protection, and *reduced system costs*—WIND-O-LINE MAKES THE DIFFERENCE!

"For the Pursuit of Scholastic Excellence"

Nesbitt **COMFORT-CONDITIONED CLASSROOMS**

The Series 600 Line is made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.
Sold also by American-Standard Industrial Division, and American-Standard Products (Canada) Ltd.

ROOF TOP

BOILER ROOM in the Brooklyn Union Gas Company Building leaves basement clear for parking 32 cars... and two

SUPERIOR PACKAGED BOILERS do the job...

The first of two 600 hp. Superior Packaged Boilers is shown being hoisted to the top of the new 14-story Brooklyn Union Gas Co. Building in Brooklyn, New York.

These two high pressure Superior Packaged Boilers . . . probably the largest ever installed so high above the ground . . . will supply both heat and hot water for the entire 14-story structure as well as heat for a second 4-story bank building to be erected adjacent to the new sky-scraper.

The roof-top installation was planned by the consulting engineers* to make more efficient use of valuable basement space which will be used for parking 32 company cars, a car-washing rack, storage, and offices for dispatchers, drivers, and building maintenance personnel. The roof-top installation also saves both the expense and the space for a chimney extending from ground to roof-top.

Each of the Superior Packaged Boilers is equipped for fully automatic operation burning gas at high thermal efficiencies. Superior's continuous gas pilot provides maximum safety of operation.

*FRANCISCO & JACOBUS
Engineers and Architects

Superior Packaged Boilers of the fire tube type are available in 17 sizes from 20 to 600 bph. Water-tube types in sizes to 60,000 lbs./hr. The catalog illustrated provides condensed data on the world's most complete line of packaged boilers. Request catalog S-14.

Fire-Tube and Water-Tube PACKAGED BOILERS

for STEAM or HOT WATER

SUPERIOR COMBUSTION INDUSTRIES INC.

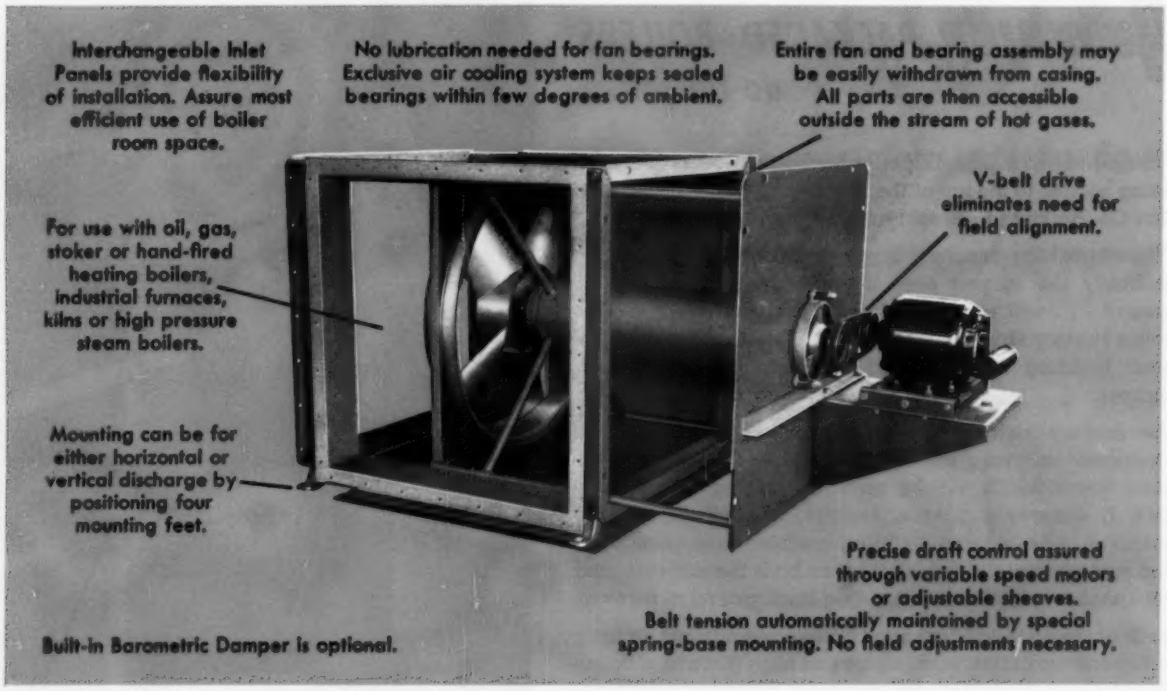
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N. Y.

SUPERIOR
PACKAGED BOILERS

WHY USE DRAFT INDUCERS?

Because:

- Draft inducers permit the use of short stub stacks eliminating the costs and unreliable operation of tall stacks.
- Draft inducers maintain slightly negative in-boiler pressure which prevents gas or fumes leaking into the boiler room.
- In small unattended boilers, draft inducers minimize the danger of gas accumulations or blowouts.
- Draft inducers, by providing uniform draft at all times, permit closer adjustment of burners than would be possible otherwise for complete and economical combustion.


Interchangeable Inlet Panels provide flexibility of installation. Assure most efficient use of boiler room space.
No lubrication needed for fan bearings. Exclusive air cooling system keeps sealed bearings within few degrees of ambient.
Entire fan and bearing assembly may be easily withdrawn from casing. All parts are then accessible outside the stream of hot gases.
V-belt drive eliminates need for field alignment.
For use with oil, gas, stoker or hand-fired heating boilers, industrial furnaces, kilns or high pressure steam boilers.
Mounting can be for either horizontal or vertical discharge by positioning four mounting feet.
Precise draft control assured through variable speed motors or adjustable sheaves.
Belt tension automatically maintained by special spring-base mounting. No field adjustments necessary.
Built-in Barometric Damper is optional.

WHY CHOOSE WING DRAFT INDUCERS?

Because:

- Wing Draft Inducers take far less room and are much easier to install in any position than centrifugal units.
- Wing Draft Inducers have led the field for over ten years.
- Wing's experience guarantees a draft inducer that is constructed to provide really long and trouble-free life.
- Wing Draft Inducers provide the unique, easy-access feature. The fan and drive equipment may be withdrawn from the housing for cleaning and maintenance without disturbing breeching connections.

WING

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DIVISION OF AERO SUPPLY MFG. CO. INC.
LINDEN, NEW JERSEY
FACTORIES: LINDEN, N. J. AND MONTREAL, CANADA

WC 149

PROVEN BEST!
DURIRON PIPE
FOR CORROSIVE WASTE DISPOSAL

For nearly 40 years Duriron has been the *only* material consistently used for "life of the building" construction when handling acid waste. There are available today, as there always have been, substitute materials. But the man who wants the best still insists upon Duriron.

Install Duriron and forget it. Embed it in concrete, bury it in the ground, hide it behind walls and false ceilings, and forget it. Duriron is installed by standard plumbing methods. Available with a *complete* line of Duriron fittings.

The complete waste disposal system in Duriron will provide safety and ease of mind for the building owner and the specifications writer, as well as confidence and ease of handling for the plumbing contractor.

Insist upon the proven material—Duriron.

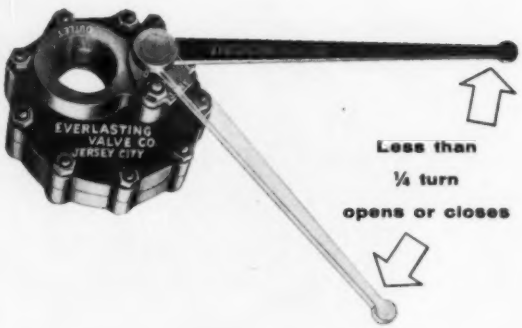
THE DURIRON COMPANY, INC. DAYTON, OHIO

DURIRON
LOOK FOR THE NAME ON EVERY PIECE

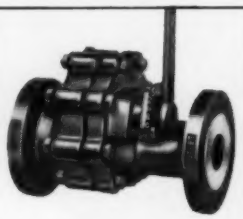
WHEN YOU NEED.....

- Quick Action
- Leak-Proof Seal
- Minimum Pressure Drop
- Straight-through full flow
- Valves that cannot wedge or jam
- Self-grinding rotating disc

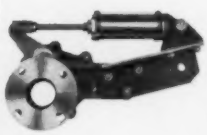
SPECIFY EVERLASTING VALVES



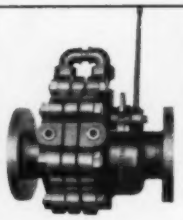
BOILER BLOW-OFF
Quick acting, also handwheel operated "Y" and angle types. For pressures up to 600 psi.



GENERAL SERVICE
Where drop-tight seal and full flow is essential.



CYLINDER OPERATED
Can be remotely controlled, electrically or manually.



STEAM JACKETED
Assures free flow of viscous materials.

WEIGHT-OPERATED
For automatic drains or emergency shut off.

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EV-407

you'll want to know...

1961: Air Conditioning's Biggest Year?

. . . industry leaders say YES

BOOM, plateau, or recession, 1961 will be air conditioning's biggest year. This is the opinion of some industry leaders whose companies exhibited at the 15th International Heating & Air Conditioning Exposition held last month in Chicago.

"Acceptance of the principle of air conditioning is increasing each year," said Frank J. Nunlist, executive vice president of Worthington Corp. "Air conditioning is bound to be a growth industry, regardless of what happens to the economy."

Forecasts $2 Billion Level

Noting that the installed value of commercial and residential air conditioning reached $1.5 billion in 1960, Joseph B. Elliott forecast a $2 billion level will be passed early in 1962. Mr. Elliott is president and chief executive officer of the York division of Borg-Warner Corp.

Russell Gray, president of Carrier Air Conditioning Co., sees an industry-wide gain in the sales of engineered, or applied air conditioning installations. He bases this prediction on an expected 5 percent increase in non-residential construction during 1961. Office building and hotel construction, both important air conditioning markets, "are expected to rise 10 and 11 percent, respectively," he said.

Gains in educational facilities and central air conditioning of apartment buildings will also contribute to industry growth. He added that there is already a heavy demand in industrial, hospital, and shopping center markets.

May Be Slow At First

Business in 1961 will be "about the same as 1960," according to Cecil Boling, president of Dunham-Bush, Inc. He expects business to be slow at first, picking up around May, and finishing stronger. He agrees that apartment, industrial, and commercial markets are the most attractive in 1961.

D. C. Minard, president of the Trane Co., said that his company will show a substantial increase in the first quarter of this year over the same period in 1960, the company's "most profitable year."

The replacement market is seen as a major factor in air conditioning sales. Equipment installed 10 years ago is just starting to wear out. Moreover, in expansion plans, it is often more economical to install a new, larger unit than to add to existing equipment.

Foreign Competition

Little competition is seen from abroad. On the contrary, manufacturers are moving into foreign markets with significant success. Trane Co. has just established two foreign subsidiaries, one in Britain and one in the European common market. Previously, Trane of Canada was the company's only foreign subsidiary. A York spokesman said its exports doubled in 1960, and would double again this year.

you'll want to know

AMCA Revises Test Code For Steam Unit Heaters

A CODE to establish uniform methods for conducting tests on steam unit heaters has been published by the Air Moving and Conditioning Association, Inc. It also serves as a standard for developing performance ratings under the AMCA Certified Ratings Program.

The Code explains the testing of heating capacity, air flow rate, temperature rise, condensate rate, and speed of rotation. A steam unit heater is defined in the Code as "a factory assembled unit employing a power driven impeller of the axial type and utilizing a heating element or coil with dry steam as the heating medium."

The Code includes definitions, descriptions of testing apparatus, instructions, and formulae for computing results and ratings. It has eliminated from the 1950 Code the free air test and the requirement for chamber calibration.

Copies of the Code, Bulletin 20, may be obtained from the AMCA national headquarters, 2159 Guardian Building, Detroit 26.

Hometown May Be Clue to Man's Performance in Heat

WHERE A MAN has lived most of his life might be the determining factor in his capacity to work in the heat. This has been substantiated by the results of an experiment in Florida involving the testing of four men from New England and five from the test state.

A comparison of the performances of the Floridians with the New Englanders showed that the Southerners' heat regulating systems were more adaptable to the climate. During the work tests, the Northerners had more sweating and higher body temperatures and heart rates. The Southerners required a shorter period for physical conditioning in the heat, and lost acclimatization at a slower rate than the Northerners.

The study was conducted by the late Professor C. P. Yaglou of the Harvard School of Public Health, Boston, Mass. He performed the experiment in cooperation with the U.S.A.F. Medical Services at Homestead Air Force Base of the Strategic Air Command. The results were published in the January 1961 issue of the Archives of Environmental Health, official publication of the American Academy of Occupational Medicine.

Glass Wall Permits Viewing of Heating, Cooling System Components

AN ATTRACTIVE showcase for the equipment of its modern central heating and cooling system plant has been provided by the Bethlehem Steel Co. An entire wall of the one-story building is constructed of glass.

Cooling of the group of buildings is provided by two absorption units using high temperature hot water as the activating medium at 308 F. Present capacity is rated at 1080 tons, with space for a potential capacity up to double this amount available.

Two high temperature hot water generators supply heating with a combined output capacity of 21,000,000 Btu per hr at 305 F. This capacity is arrived at by boosting the boiling point through pressure control. Pressure is maintained with nitrogen pressurization of the expansion tank.

The high temperature, high pressure hot water system was selected because its distribution was considered advantageous to the plant site contour variations.

The glass wall enables the onlooker to see a large sphere, the high temperature hot water expansion tank; two high temperature hot water generators, one of which is visible as a large cube; and at the far right, one of the two absorption units. Color coded piping adds a splash of brightness to the picture.

Texas Elementary School Windowless, Air Conditioned

CONSTRUCTION has begun on the first completely air conditioned elementary school in southeast Texas. Dayton Elementary School will have a gas heating and cooling system that permits zone control throughout the building.

The fireproof, windowless building was designed with concrete frame and slab foundation, and double masonry walls. The outside walls are furnished with buff face brick, the inside with glazed tile. The school contains more than 39,000 sq ft of floor space, with 26 classrooms, offices, and a cafeteria-auditorium. Corridors, rest rooms, kitchen, and the cafeteria-auditorium have terrazzo floors.

The automatic gas heating and cooling system circulates chilled or heated water to offices, classrooms, or other areas. Simultaneous heating and cooling is available in different areas. The individual temperature control is obtained by circulating chilled water through a natural gas engine-driven reciprocating compressor. Hot water circulated through the system is obtained from the engine jacket. Each room has a modulating thermostat.

Since the building is windowless, an emergency lighting system is provided for all areas. An emergency generator will supply power in case of line failure.

All classrooms have clocks, public address speakers, intercom systems, and wash basins.

The project is expected to cost $364,524, or $9.32 per sq ft. Mechanical engineer Reese J. Brentzel said the economical design of the building "saves enough to pay the operating costs of the heating and cooling system."

Architects for the project are Wylie W. Vale, A.I.A., and E. D. Carter and E. A. Wilpitz, Associates. Williamson Plumbing and Supply Co. is the mechanical contractor.

Air Conditioning Plus Security For Bank Vaults

SECURITY REQUIREMENTS for the walk-in vaults at the First National Bank in Minneapolis, Minn., are met without sacrificing proper ventilation for the spaces during banking hours.

The ventilating duct leading to the vault space is hinged as shown at right. After hours, the duct is swung up and out of the way, allowing room for a tamper proof door to be closed over the opening.

A battery of electronic air cleaners serves to keep dust and dirt from the vault when the duct is clamped in place, according to Minneapolis-Honeywell Regulator Co.

Sun Reflecting Screens Reduce Cooling Load

SOLAR HEAT can be an obstacle to maintaining proper air conditioning and heating. This is particularly true in the systems of office buildings that have large window areas.

The Minneapolis headquarters of North American Life and Casualty Co. was built with a cooling capacity of 285 tons. This was considered sufficient for the 53,750 sq ft building. But several uncomfortable summers proved that the cooling capacity did not solve the problem of solar "heat spots." The sun made some areas too warm, and there was no way of cooling them without over cooling the shaded area.

The problem was solved with the installation of sun reflecting screens, according to the Reflectal Corp. These screens blocked entry of direct rays from the sun, eliminating the hot spots.

Peak heat load was cut by 97 tons of cooling. A uniform cooling effect was created, and workers in all areas of the building were comfortable.

The sun reflecting screens used in this application are miniature venetian blinds with louvers of bronze wire 0.05 in. wide and 0.005 in. thick. The louvers are set in frames at an angle of 17 deg, considered to be optimum for all day use. Up to 18 percent of the sun's rays are reflected to the outside.

Gas Utility Gives College Air Conditioner To Promote Research in Higher Education

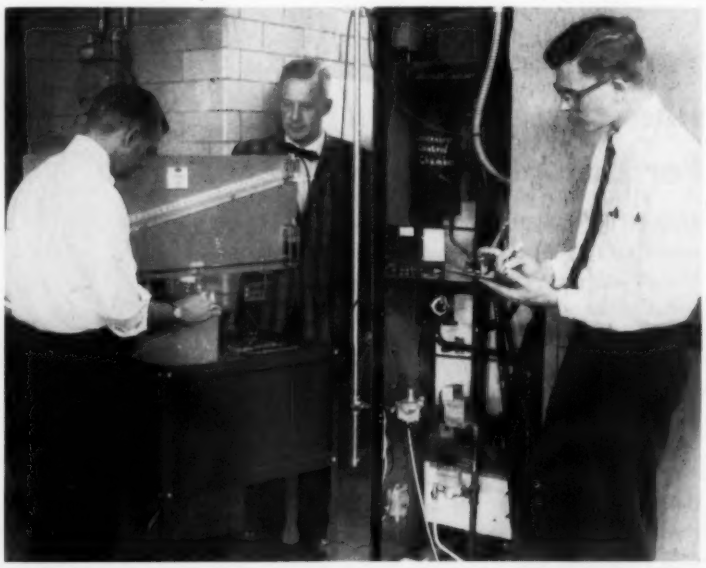
A 3½ TON year around air conditioner has been given to the College of Engineering at the University of Bridgeport to promote research in the field of higher education. The benefactor is the Bridgeport Gas Co., Bridgeport, Conn., according to the American Gas Association.

The unit is a gas-operated absorption type, performing the function of cooling, dehumidiying, air cleaning, and circulation in summer; and heating, air cleaning, and circulation in winter. Installation in the heat and power laboratory of the mechanical engineering department has already been completed.

The sheet metal panels on the unit have been removed and replaced with plastic view panels to permit the interior components to be clearly visible so that the students may observe the cooling-heating coil.

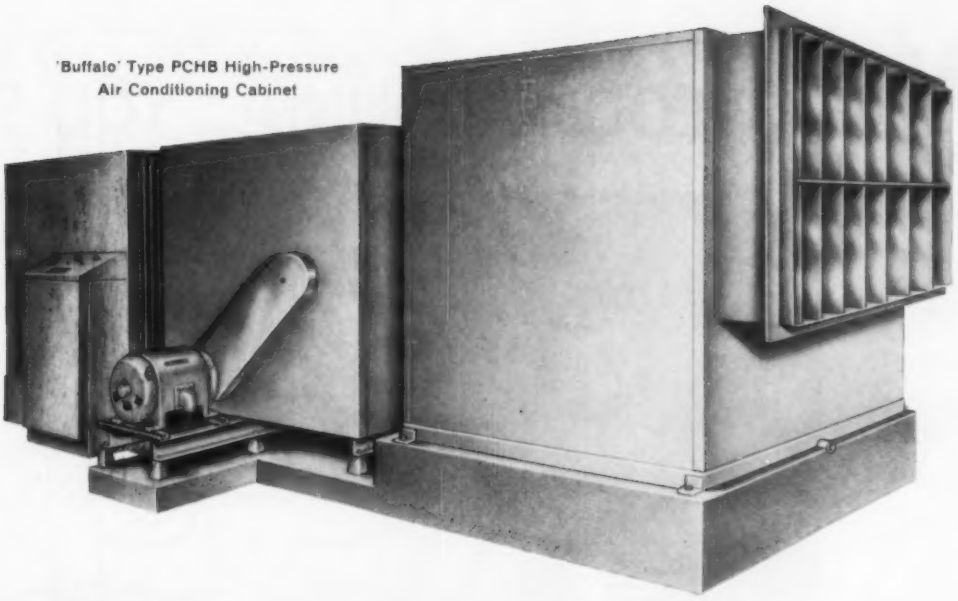
A test table adjacent to the unit permits students to measure the quantity of air passing through the unit and the temperatures at selected points throughout the sys-

. . . continued on page 198



STUDENTS test various operations of year around air conditioner under the supervision of Professor George M. Nixion, University of Bridgeport

'Buffalo' Type PCHB High-Pressure
Air Conditioning Cabinet



NEW 'BUFFALO' HIGH PRESSURE UNIT FOR MULTI-ZONE OR DUAL-DUCT AIR CONDITIONING SYSTEMS

Embodying all the proven construction features that made 'Buffalo' low-pressure Zone Control Cabinets popular with the industry, these new 'Buffalo' Cabinets are designed to operate at static pressures up to 8″.

Check these quality features:

RUGGED, COMPACT COIL SECTION

- Husky tubular frame — removable panels counter flashed at all seams for minimum air leakage.
- Vertical or horizontal discharge models for minimum floor space or headroom requirements — no discharge elbow needed.
- Heavy-gauge zone dampers, stainless steel blade journals — zones individually sized for CFM requirements, for accurate adjustment of balancing dampers.

EFFICIENT TYPE BL FAN SECTION

- Isolated from filter and coil sections by flexible neoprene connections.
- Fan, motor and drive assembly rigidly held in permanent alignment by rugged integral structural channel base.
- Time proved Type BL Fan with characteristics of particular advantage in a high-pressure system: — high efficiency over broad operating range — low noise level — non overloading horsepower characteristic — steep constant rising pressure characteristic for minimum capacity change in switching from hot to cold deck operation — stationary inlet guide vanes for stable performance under adverse inlet conditions — low fan cutoff velocities eliminate need for bulky diffuser section, providing excellent coil velocity distribution with minimum coil wiping.

Write today for new Bulletin **AC-152**

AIR HANDLING DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

LOOK AROUND... YOU SEE

LIBBY-OWENS-FORD
OFFICE BUILDING
Chicago, Ill.

Architect:
Skidmore, Owings & Merrill

Mechanical Engineer:
Guy B. Panero

Project Engineer:
Edward Pita

Contractor:
Stanley Carter

REQUIREMENT: The specification called for a low height cooling tower to be furnished with Corrugated Corrulux (reinforced fiberglass) in lieu of the standard casing of Corrugated Transite.

SOLUTION: PHILLIPS COOLING TOWER custom-engineering easily permitted the substitution and therefore the cooling tower at the home office of Libby-Owens-Ford is encased with Corrulux. The Corrulux is manufactured by Libby-Owens-Ford.

EVERY STEP CUSTOM ENGINEERED

CASINGS
Selection of material to fit Architectural treatment and surrounding conditions.

BASINS
Redwood, stainless steel, galvanized steel, carbon steel up to and including ¼" thickness with any desired coating, reinforced concrete basins supported on steel beams.

DISTRIBUTION SYSTEM
Spray nozzle type or open Weir gravitational type system.

FANS
Multi-blade, adjustable propeller type fan in cast aluminum, stainless steel or Monel. Either direct driven fan in small sizes or indirect right angle worm gear drives.

FILL
Redwood or pressure treated Douglas Fir. Slip-fit, self-supporting for easy removal for interior maintenance.

FRAMEWORK
Hot dipped galvanized structural steel .250" minimum thickness. Redwood or pressure treated Douglas Fir.

Phillips

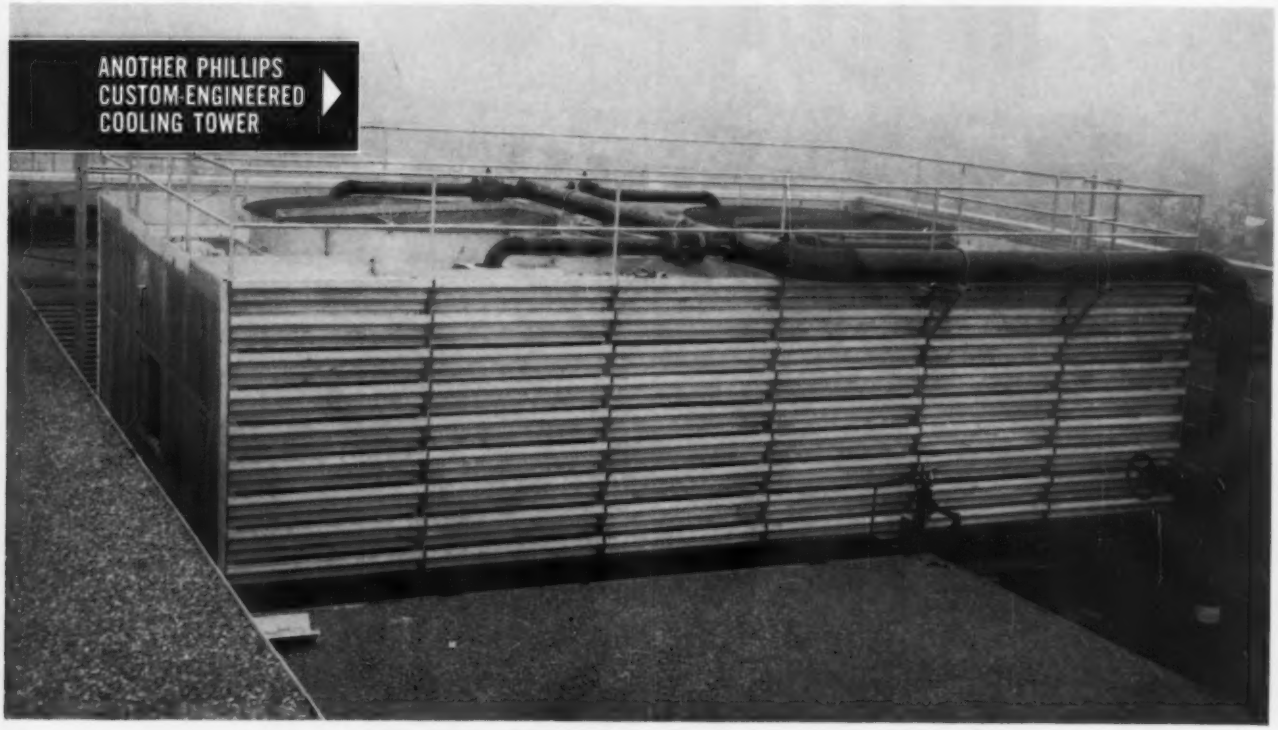
CUSTOM-ENGINEERED COOLING TOWERS

EVERYWHERE!

North . . . east . . . south . . . west—coast-to-coast and throughout the world you'll find PHILLIPS CUSTOM-ENGINEERED COOLING TOWERS on outstanding buildings everywhere.

And no wonder! For PHILLIPS are the only cooling towers custom-engineered to give you the most efficient . . . most economical solution for your particular problem.

Put PHILLIPS research and development experience to work on your next cooling tower problem. You'll like the results.



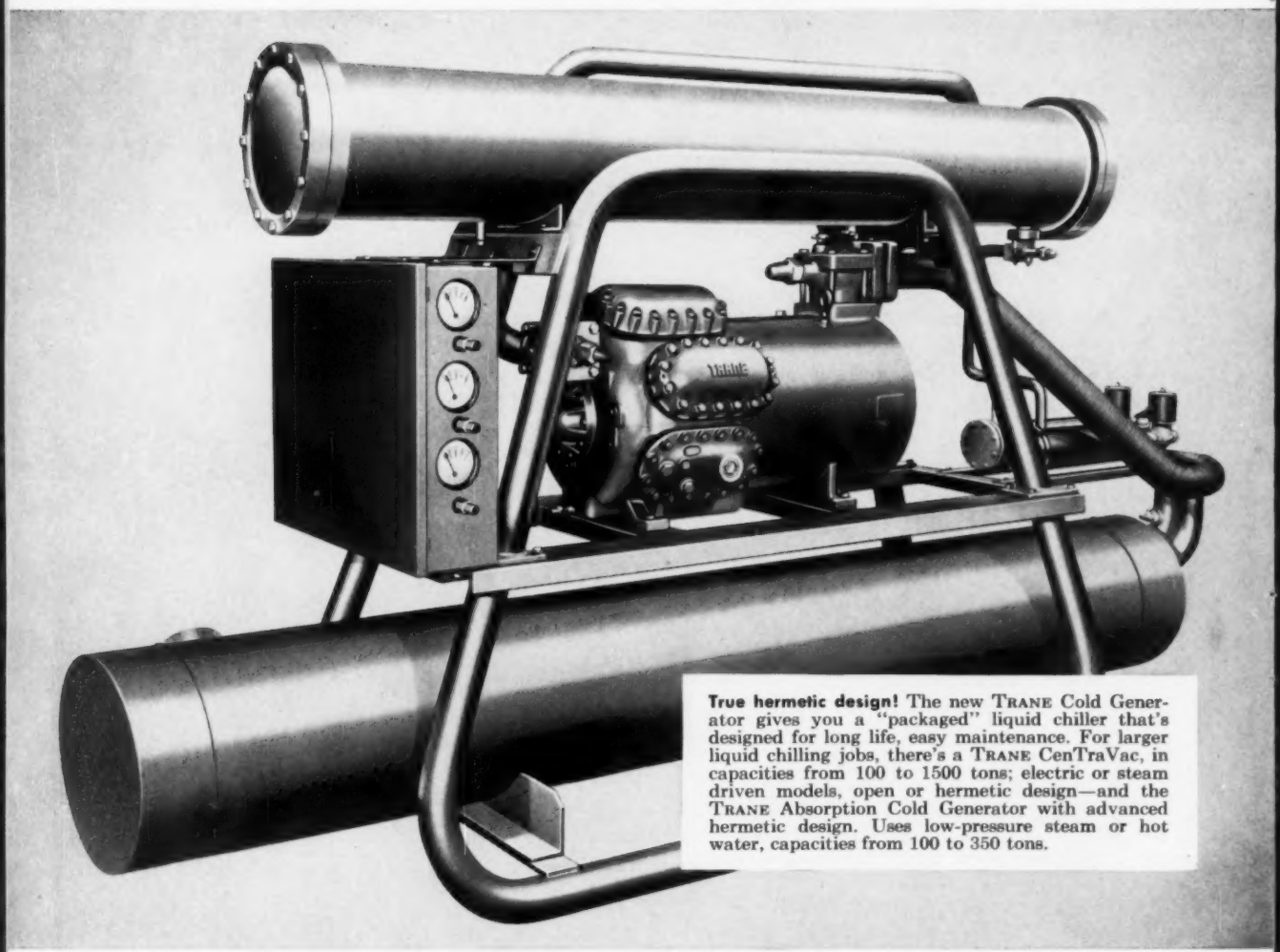
Write for literature

SPECIAL FEATURES ON ALL TOWERS

Corrosion Resistant Hardware. Aluminum or Stainless Steel Fans. Nailless Redwood Filling Removable at Tower Base. Nailless Three-Pass Redwood Eliminators. Removable Louvers.

Phillips Cooling Tower Co., Inc.
220 DUPONT ST., BROOKLYN 22, N. Y.

Cut liquid chilling costs-with this new Trane



True hermetic design! The new TRANE Cold Generator gives you a "packaged" liquid chiller that's designed for long life, easy maintenance. For larger liquid chilling jobs, there's a TRANE CenTraVac, in capacities from 100 to 1500 tons; electric or steam driven models, open or hermetic design—and the TRANE Absorption Cold Generator with advanced hermetic design. Uses low-pressure steam or hot water, capacities from 100 to 350 tons.

Now! A hermetic model of the Trane Reciprocating Compressor!

Here's a new, efficient Reciprocating Compressor that's *fully hermetic*, designed for the more rigorous demands of R-22. This unit is of single-housing construction. Motor and compressor are in one shell, with a bolted end cover for easy access. This minimizes alignment problems experienced with other hermetic compressors that have 2-part housing.

The new TRANE Hermetic Reciprocating Compressor has multi-step capacity control that saves power by reducing starting, stopping. And the truly hermetic design eliminates crankshaft seal and coupling to provide quiet operation, simplified installation, longer life.

Check these features:

- **Designed for R-22 and R-12** (not a converted R-12 machine).
- **Single-housing construction** for simplified installation, trouble-free operation, easy access for maintenance.
- **Multi-step capacity control** reduces starting, stopping, saves power.
- **Exclusive internal thermal protector,** located in the motor windings, protects against any condition that causes high motor temperatures.
- **Large suction chamber** and cylinder head safety springs provide protection against refrigerant slugging.
- **Available** in sizes from 10 to 150 tons.

for comfort or process-
Hermetic Cold Generator

Advanced hermetic design assures long, trouble-free life, quiet operation. Cuts installation costs.

Here's low-cost, efficient liquid cooling for process or comfort—from TRANE, long an industry leader in reciprocating water chillers. It's the new TRANE Reciprocating Cold Generator, now *hermetic*, with TRANE chiller and condenser —plus a new TRANE Hermetic Compressor (illustrated and described below).

A major step forward in industrial liquid cooling equipment, this new Hermetic Cold Generator features lightweight, compact design that simplifies installation and maintenance. It is completely factory-wired and assembled, with prewired control panel mounted directly on the unit to eliminate much on-the-job installation labor. Designed for R-22 and R-12, it is available in a complete range of 11 sizes from 10 to 100 tons.

When you plan industrial liquid chilling equipment—for processing or air conditioning—contact your nearby TRANE Sales Office for facts on the complete line of TRANE water chillers from 10 to 1500 tons; or write TRANE, La Crosse, Wisconsin.

Check these advanced TRANE features:

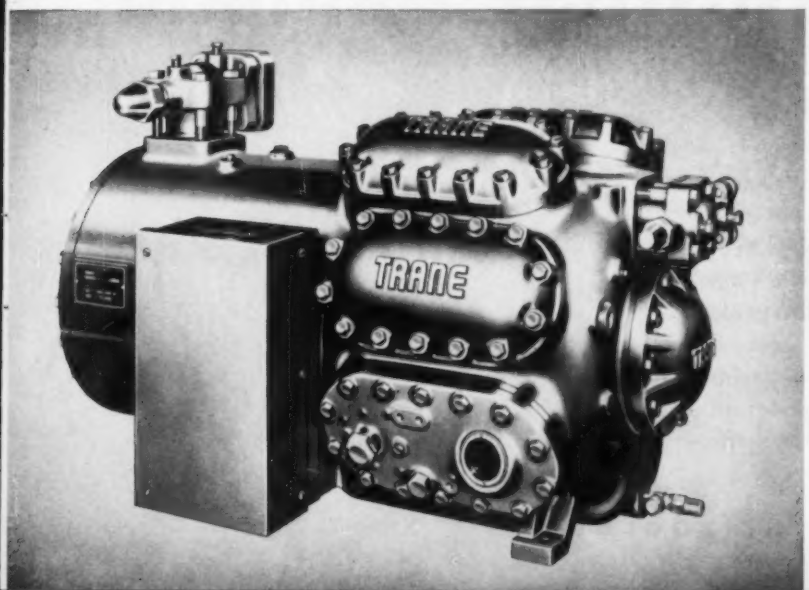
- **All major components,** chiller, condenser, compressor, designed and built by TRANE.
- **Advanced hermetic design** assures maximum efficiency, simplified maintenance and installation.
- **Compact size;** small enough to pass through a standard 36″-wide door.
- **Packaged design;** factory-wired and assembled to cut on-the-job labor. Pneumatic or electric control panel mounted and prewired.
- **Versatile.** May be used for any process or comfort liquid cooling application . . . to maintain constant temperature for electro-plating baths and other critical operations. Units available for use with evaporative or air-cooled condensers.

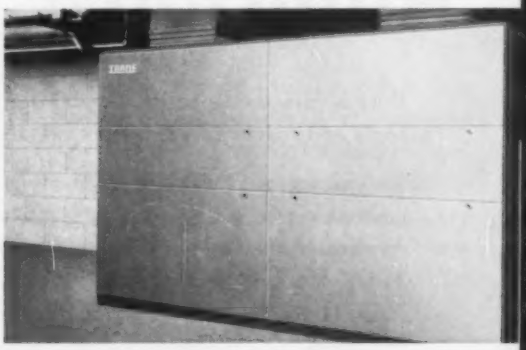
For any air condition, turn to

TRANE

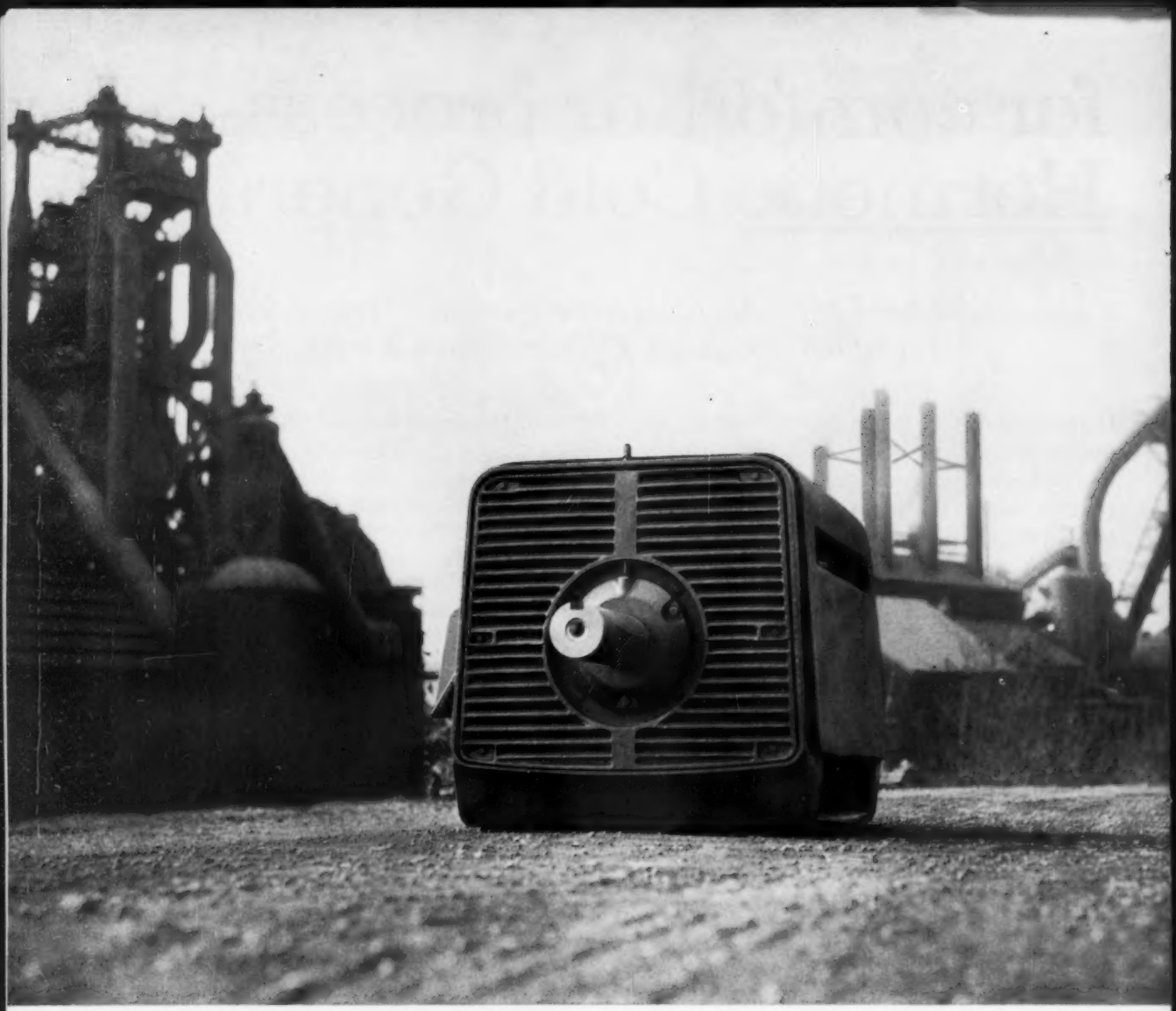
MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 100 U. S. AND 19 CANADIAN OFFICES





Trane Commercial Self-Contained Air Conditioners feature the new TRANE Hermetic Compressor. Quiet and compact, these units provide maximum cooling comfort for office, laboratory or factory areas. Job-matched to fit your budget, fit your needs. Air or water-cooled models in sizes from 10 to 50 tons.



America's Newest Compact

Here is how the Reliance D-5000 design shrinks, cools and quiets 125-2000 hp. motors.

This new, great cubic design gives you more horsepower in less space . . . actually the frame dimensions that held 150 hp. now contain 300 hp. There is better heat dissipation from the frame itself. Air flows easily through the entire grilled end areas . . . exhausting through long, protected slots at the sides and bottom. New fingerless ducted rotor design also means considerably better cooling than any other previous motor. Noise level is held to a minimum.

Reliance has incorporated all other Duty Master plus features into this motor . . . ball or sleeve bearings, special lubrication design, drip or splash-proof and complete open motor protection in its insulation characteristics. The Reliance Duty Master is built up to 2,000 horsepower; the D-5000, available now, runs from 125 to 300 hp.

The Reliance Sales Engineer that serves you is anxious to tell you the full story of this new Duty Master. Call him. He's in the Yellow Pages.

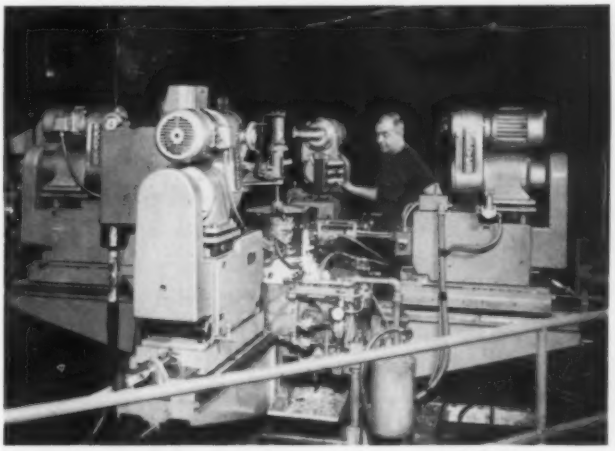
BUILDERS OF THE TOOLS OF AUTOMATION

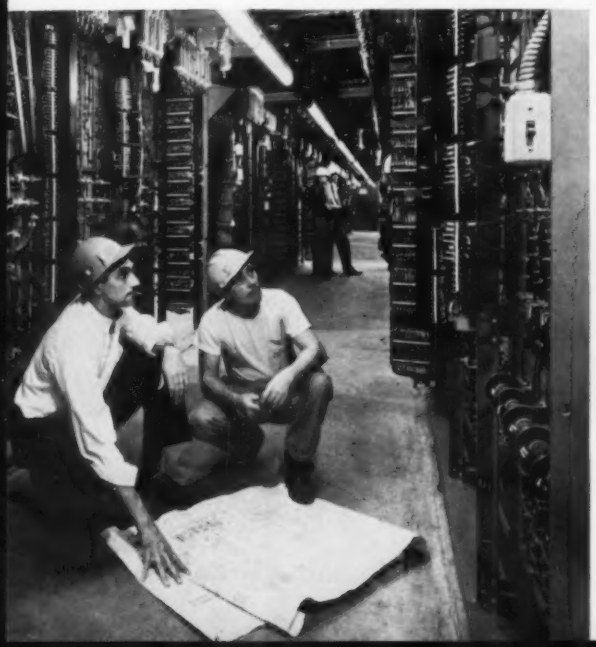
A-1684

ONE SELF-CONTAINED, COMPACT POWER PACKAGE. This MASTER GEARMOTOR has been operating outdoors for 5 years regardless of weather. It has no exposed high speed couplings, no V-belts, chains or sprockets. Engineering and assembly costs are reduced. You can simplify installations and save space with vertical, horizontal and flange mountings; output shaft over, under, left or right. Ratings 1/8 to 125 hp. in right angle, parallel or in combination. Right angle ratios are available up to 96:1; parallel 120:1. Bulletin A-1684.

CONTOUR EPOXY-COATED TO ELIMINATE ENCAPSULATION CRACKING. New RELIANCE ENCAPSULATED MOTOR . . . gives you positive protection from dust, dirt, acid and water. Unlike other heavy molded coatings, stator windings are vacuum-impregnated with epoxy resin at a uniform thickness, follow the contour of the windings. You get maximum flexibility, tensile and bond strength, plus quicker cooling . . . all vital to superior motor performance. Bulletin B-2108.

INFINITELY VARIABLE OUTPUT SPEEDS AT LOW COST. REEVES MOTODRIVES, shown here powering this 4-position drilling and boring machine, are used extensively for hundreds of production needs. Horsepower ratings from ¾ to 40, speeds from 1.71 to 4660 rpm. Speed variation ranges from 2:1 to 10:1. Available in hundreds of space-saving assemblies . . . with manual, remote or automatic process control (Airtrol). Bulletin M 592.





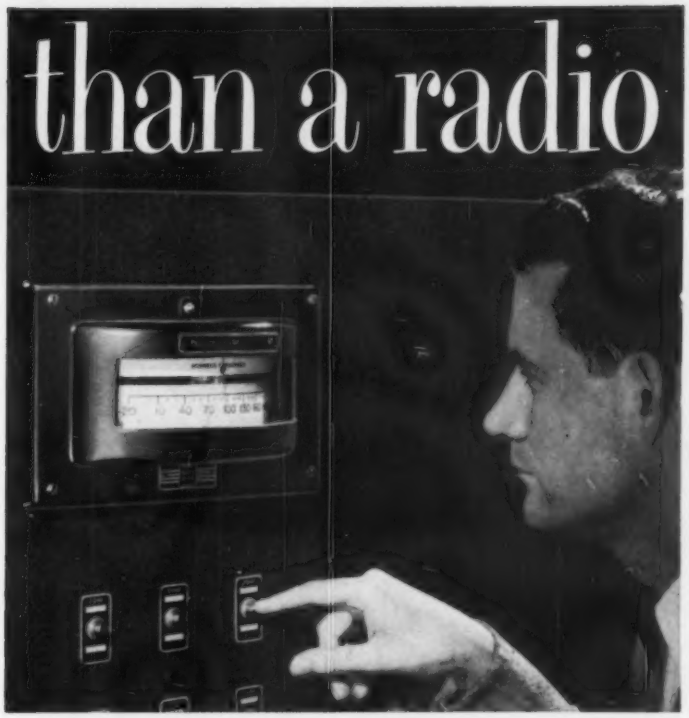
TOTAL SERVICE is an integral part of every Reliance product, from engineering and start-up assistance to maintenance and renewal parts. The photo shown here is typical of a Reliance Service Engineer's on-the-job availability—for maintenance and consultation on knotty problems. Every Reliance Sales Engineering Office and Distribution Center—nationwide—gives you the attention and experience necessary to assure the top performance you expect from the Reliance equipment you buy.

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 363A, CLEVELAND 17, OHIO • Canadian Division: Toronto, Ont.

ELECTRONIC control .

. . . simpler than a radio



More reliable than an elevator

Everywhere you turn, reliable electric and electronic components and systems work for you. You hardly think about them — your radio, an elevator, your dictating machine, the generator cutoff in your automobile.

Barber-Colman *Electrionic* control for heating, ventilating, and air conditioning provides even more dependable service than the items listed above. It combines electric and electronic components to give you fast, accurate sensing and adjustment of temperatures and air flow. You don't have to convert electrical energy into mechanical energy in an *Electrionic* control system — it makes direct use of the electrical power that's available in every building.

Simpler than a radio, it's easy to service. More reliable than an elevator, it seldom needs attention. It is instantaneously responsive and extremely accurate. For large or small installations, *Electrionic* control often costs less in the first place, and always costs less in the long run.

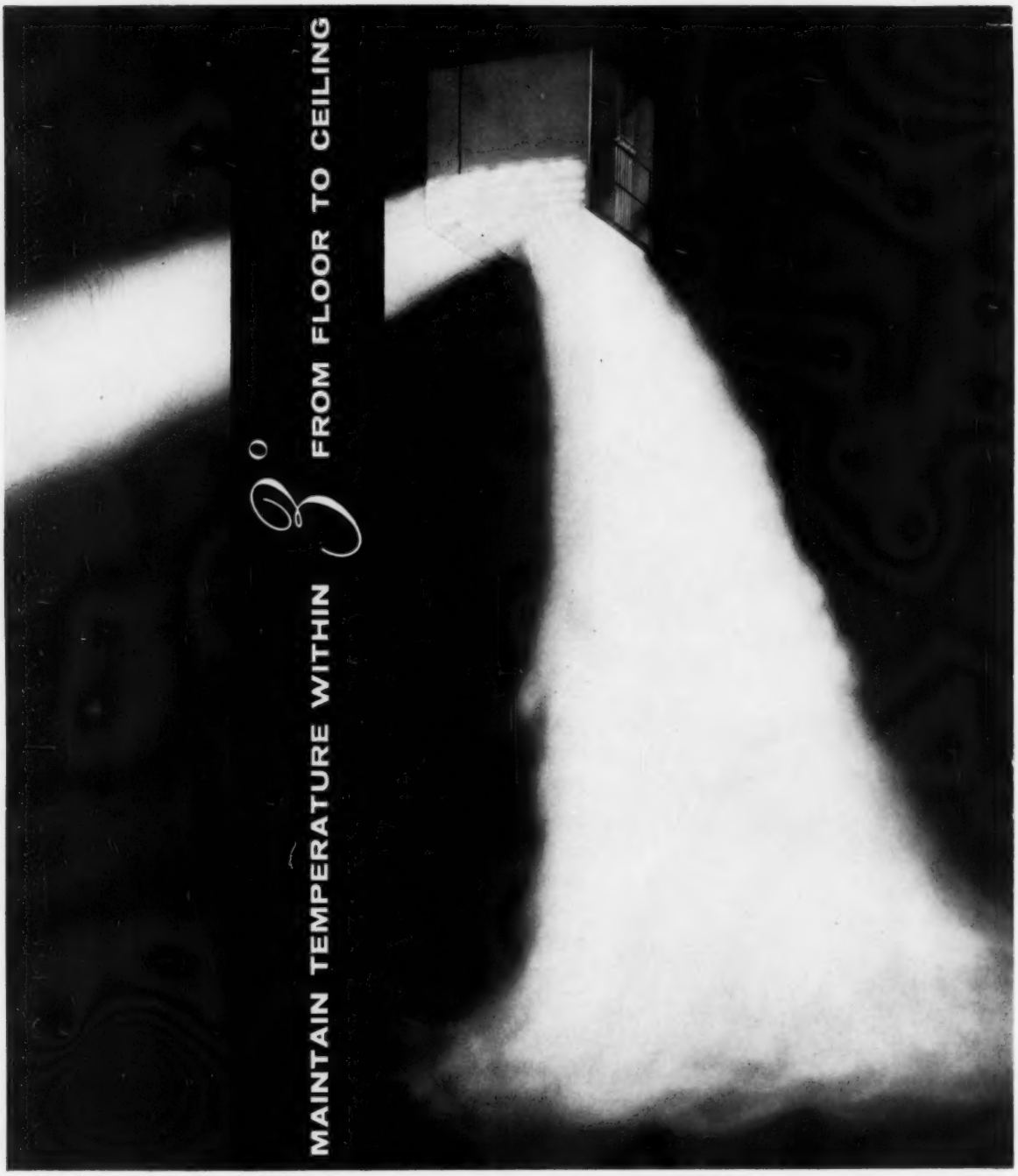
You don't have to be an electric or electronic engineer to understand *Electrionic* control. You will feel right at home with it after you've read Barber-Colman's new *Electrionic* Handbook which graphically explains the principles in a very readable way. You're welcome to a copy. Just call your local Barber-Colman automatic controls office or write:

. . . to operate transistorized motor operators for accurate control of air and liquid flow.

BARBER COLMAN

BARBER-COLMAN COMPANY

Dept. O, 1301 Rock Street, Rockford, Illinois



MAINTAIN TEMPERATURE WITHIN 3° FROM FLOOR TO CEILING

ARKLA-Humphrey UNIT HEATERS

Arkla-Humphrey Multi-Directional unit heaters are accepting congratulations now. At long last, industry's toughest heating problems have been solved by the Multi-Directional!

Tests show a 15.38% fuel saving with only a 3° temperature differential from floor to 18' ceiling! Smoke photo above shows you why. The Multi-Directional is the first and only unit heater to discharge heat straight down, out in front, or from either side, or any combination of these three! Pulling the heat from the ceiling with top mounted fans eliminate overheated ceilings, too.

Write for complete information.

MANUFACTURED BY GENERAL OFFICES ARKLA AIR CONDITIONING CORPORATION SHANNON BUILDING LITTLE ROCK, ARKANSAS

for ZONE CONTROLLED

heating and air conditioning

HAYS HUSH-A-MATIC

FLOW CONTROLS

ZONE CONTROL VALVES FOR · HOTELS · MOTELS
HOSPITALS · SCHOOLS · OFFICES · HOMES · APARTMENTS
CHURCHES · FACTORIES · SHIPS

AUTOMATIC CONTROLS DIVISION
HAYS MANUFACTURING COMPANY
ERIE, PENNSYLVANIA

FOR TRADE DISCOUNT INDICATE CLASSIFICATION

GENTLEMEN:

We are interested in Hush-A-Matic zoning . . . please send complete information and prices at once.

NAME ..... POSITION .....

FIRM .....

ADDRESS .....

OUR CLASSIFICATION IS:

☐ ARCHITECT—ENGINEER ☐ DISTRIBUTOR ☐ MAINTENANCE
☐ DEALER—CONTRACTOR ☐ MANUFACTURER ☐ OTHER

HUSH-A-MATIC

ELECTRIC ZONING VALVE

SELF PURGING . . .
SOLDER ASSEMBLED

For Heating and Air Conditioning Fan Units • Convector Units

WATERPROOF
KAST-COIL SOLENOID
GUARANTEED
FOREVER

A NEW CONCEPT IN PERFORMANCE IN SOLENOID VALVES

SILENTLY OPENS NO CLICK . . . NO SURGE	**RELIABILITY** CONTAMINATION-PROOF PERFORMANCE
SILENTLY OPERATES NO HUM . . . NO GURGLE	**RELIABILITY** WATER-PROOF ENCAPSULATED SOLENOIDS
SILENTLY CLOSES NO HAMMER . . . NO VIBRATION	**RELIABILITY** CORROSION-PROOF BRONZE AND TEFLON
SILENTLY CYCLES NO SERVICING . . . NO ADJUSTING	**RELIABILITY** TEMPERATURE-PROOF TEFLON PARTS

SILENT . . . RELIABLE

FIRST CLASS
PERMIT NO. 189
ERIE
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Automatic Controls Division
HAYS MANUFACTURING COMPANY
851 West Twelfth Street
Erie, Pennsylvania

FOR MORE "INFO"
ON HAYS HUSH-A-MATIC
ZONING . . .

SEND THIS
CARD
TODAY!

The Complete Line of Packaged

COOLING TOWERS . . .

Havens

COOLING TOWERS

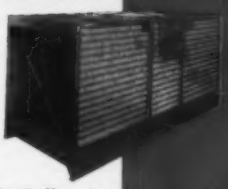
V. M. SERIES

80 thru 150 tons

Havens VM Series packaged cooling towers are shipped pre-assembled, incorporate internal piping, and are all steel constructed with California Redwood fill. The largest tonnage installation can easily be accomplished at lower cost by adding additional packaged towers.

"V" SERIES

80 thru 200 tons



The Packaged Cooling Tower that gives you flexibility on all types and sizes of installations. The Multi-Cell units can be easily added together for top capacity. The "V" Series features side panels for corrugated cement asbestos.

HAVEN "33-SERIES"

5 thru 75 tons

The "33-series" is recommended for residential and small commercial installations. The units are shipped assembled, ready for installation.

"C-B-C" SERIES

10 thru 150 tons

These rugged towers, feature access panels for quick and easy inspection. Designed for Indoor or Outdoor use.

Havens COOLING TOWERS

Division of

Havens Structural Steel Company

1713 Crystal Kansas City 26, Missouri

"City in the sky" will be heated and air conditioned with the help of some 2000 tons of Bethlehem Steel Pipe*

Pan Am Building, the world's largest commercial office building, is scheduled for completion in late 1962. Rising 59 stories tall, on a site directly behind New York's Grand Central Station, it will house a population of 25,000 people working in nearly 22,000,000 cubic feet of air-conditioned comfort.

Continuous Buttweld to 4 in., nom. Electric Resistance-Weld to 16 in., OD

Owner: Grand Central Building, Inc.; Erwin S. Wolfson, President; Jack Cotton, Chairman. Architects: Emery Roth and Sons. Design Consultants: Walter Gropius; Pietro Belluschi. Structural Engineer: James Ruderman. Mechanical and Electrical Engineers: Jaros, Baum and Bolles. General Contractor: Diesel Construction Company, Inc.; Carl A. Morse, President. Mechanical Contractor: Raisler Corp. Pipe Jobber: Chas. F. Guyon, Inc.

Steel

for Strength . . . Economy . . . Versatility

Always insist on steel pipe made in U.S.A.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Wrap up tough duct insulating jobs fast with ULTRALITE®

Unusually shaped duct systems, such as the one recently installed in the showroom of the Jerry Green Car Agency, Kansas City, Mo., are faster, easier, and more economical to insulate with ULTRALITE. Made exclusively of long, strong textile-type glass fibers, ULTRALITE is extremely lightweight and flexible, making it easy to wrap around oddly-shaped duct systems. What's more, its high resilience keeps ULTRALITE from compressing and losing its maximum thermal efficiency at the corners of the duct. Ease of handling makes ULTRALITE particularly desirable where working conditions are cramped or otherwise confining.

For high thermal efficiency, low installed costs and permanence, your best insulation buy is ULTRALITE. Write today for complete information.

FOR INFORMATION AND DELIVERY
CALL YOUR LOCAL ULTRALITE DISTRIBUTOR
(LISTED IN THE YELLOW PAGES)

GUSTIN-BACON *Manufacturing Co.* GUSTIN gb BACON®

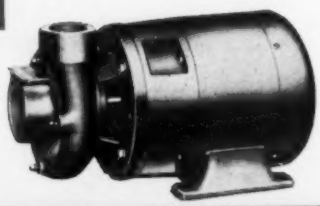
220 W. 10th St. Kansas City, Mo.

Thermal and acoustical glass fiber insulations . . . Molded glass fiber pipe insulation
Couplings and fittings for plain and grooved end pipe

For AIR CONDITIONING— HEATING— or GENERAL WATER SERVICE

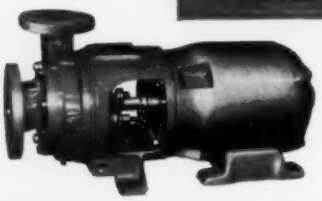
***ONLY** Ingersoll-Rand can offer you such a complete line of pumps!*

THE "K" LINE OF MOTORPUMPS



These off-the-shelf Motorpumps are built in sizes from ⅓ through 25 horsepower to suit any condition to 775 gpm with heads to 190 ft. Advanced engineering and exacting manufacturing have produced these Motorpumps which handle liquids from −30°F to 211°F. Easily hooked up, they are ideal for air conditioning, heating or general water service. They are furnished in screwed connections from ¾″ to 3″.

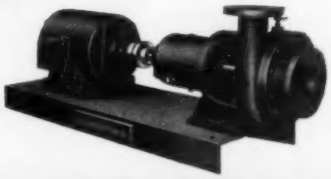
THE "RV" LINE OF MOTORPUMPS



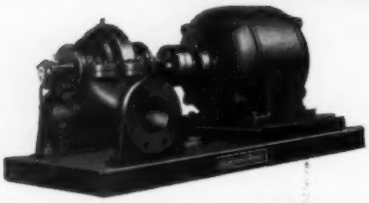
The class RV Motorpumps are made as single, two or four stage units available with screwed or flanged connections from 1″ to 6″. The extra-heavy construction with oversize shaft and bearings assure the maximum in dependability and performance. Built in 1 through 75 hp size these rugged units can deliver up to 3200 gpm . . . heads extend to 650 ft. This Motorpump line is well-suited for large air conditioning installations, heating (to 250°F), boiler feed or general water service.

THE CRADLE LINE OF PUMPS

Hydraulically and physically, the pump ends of these units are the same as those used on the close-coupled RV line of Motorpumps. For a given pressure, capacity and shaft speed, impellers and other parts are interchangeable. The cradle construction permits a variation of type of driver that can be removed or replaced without disturbing the pump intake or discharge piping. Sizes ¼ through 100 hp to handle liquids of temperatures to 400°F.



HORIZONTALLY SPLIT LINE OF PUMPS



Here's a really complete line of single or two stage, double-suction pumps for such service as cooling water circulation in condensers, cooling tower systems, air conditioning equipment, drinking water supply, heating, etc. Built in 1½ through 10 inch discharge sizes, deliveries range to 4000 gpm and heads extend to 1100 ft. Horsepowers range to 400 and liquids can be handled to 400°F.

over a century IR *of pump progress*

from the leading manufacturer . . .

Ingersoll-Rand

79A9 **11 Broadway, New York 4, N. Y.**

Engineered to

RETAIN YOUR PRODUCT LEADERSHIP

Alco Designed
CONTOUR POWER ASSEMBLY
Increases power element life as much as 10 times over other designs by reducing extreme flexing of the diaphragm. Standard construction on all ALCO "T" Series and "HTL" Series.

Alco Designed
RAPID RESPONSE REMOTE BULB AND WELL
- Reduces danger of floodback
- Extra-quick closing response
- More efficient control over wider range of operating conditions
- Economical to install in package units
- Available on all Alco Gas Charged Valves when specified

Alco Designed...
for easy capacity changes or cleaning without breaking connections or removing valve from line.
Simply . . . loosen **2** bolts . . . lift out cage . . . clean and replace.

ALCO T-SERIES
*THERMO EXPANSION VALVES

• Refrigerants: FREON-12 from ½ ton to 50 tons, FREON-22 from 1 ton to 80 tons, CARRENE-7 from ¾ ton to 60 tons, PROPANE from 1 ton to 88 tons • 2 BODY DESIGNS meet every requirement—STRAIGHT THRU CONNECTIONS or RIGHT ANGLE CONNECTIONS • WIDE VARIETY OF CONNECTIONS (Outlets to match distributor requirements • EXTERNAL or INTERNAL EQUALIZER • EXTERNAL or INTERNAL SUPERHEAT ADJUSTMENT • TIGHT SEATING . . . STAINLESS STEEL STEM AND SEAT • CORROSION-RESISTANT MATERIALS • MOUNT IN ANY POSITION • NO SPECIAL WRENCHES or GUIDES REQUIRED FOR CLEANING AND SERVICING

Call your ALCO WHOLESALER—Write for Bulletin 171-56

• BUY SECURITY
• BUY QUALITY
• BUY ALCO

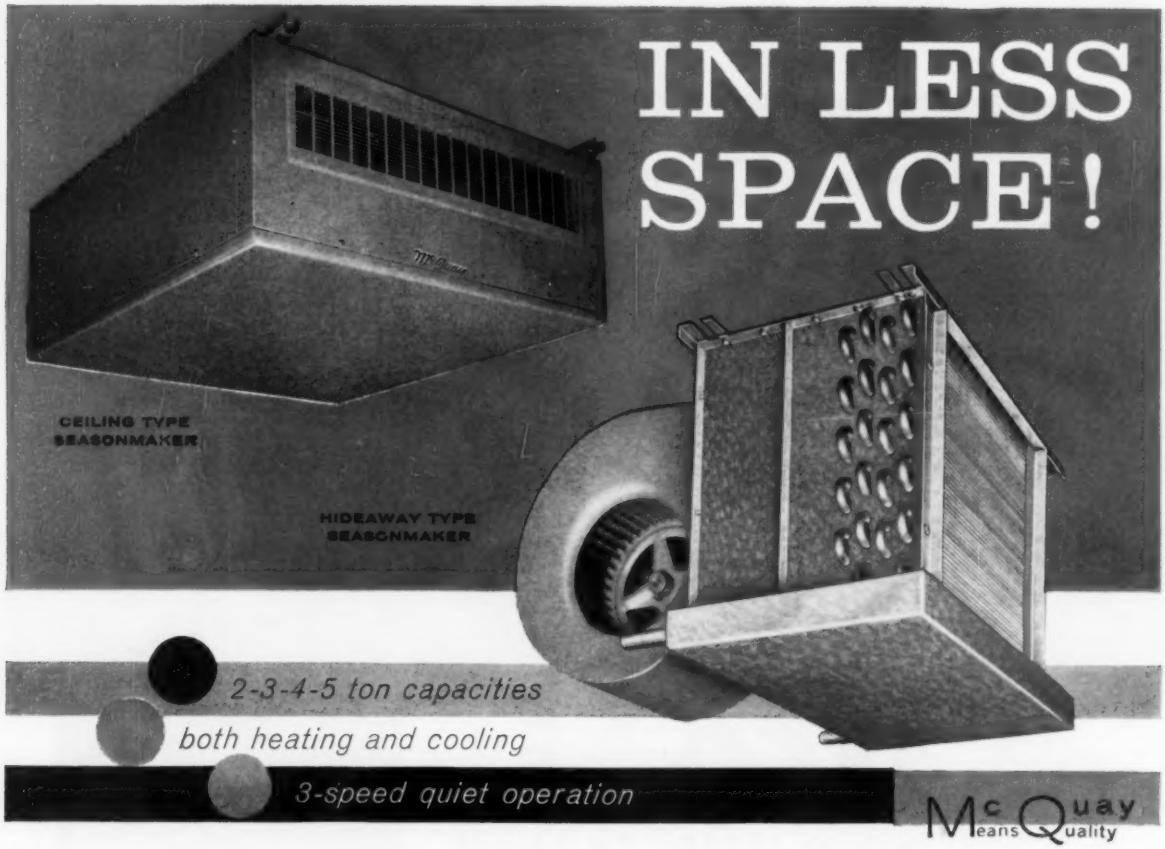
ALCO VALVE CO.
561 KINGSLAND AVE. • ST. LOUIS 5, MO.

8218

The one complete line of refrigerant controls: Thermostatic Expansion Valves • Refrigerant Distributors • Solenoid Valves • Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves

now you can install these new compact **2 to 5 TON**

SEASONMAKERS

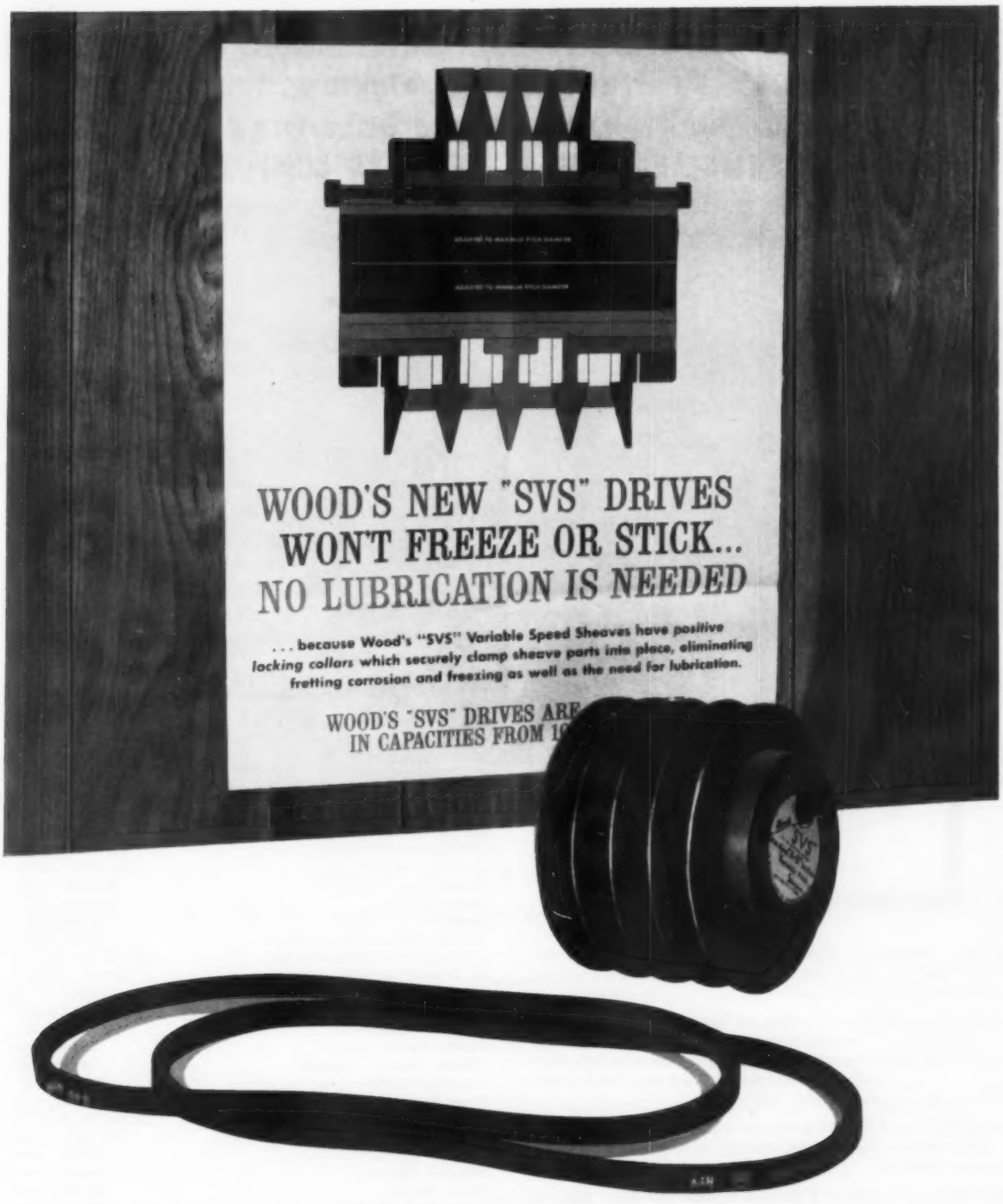


Heated, filtered air in cold months—cooled, dehumidified, filtered air in hot months . . . . McQuay large capacity Seasonmakers provide year 'round comfort for residences and for multi-room commercial buildings such as hotels, motels, apartments, schools and offices where a direct air distribution system is used. Medium to large areas requiring 2, 3, 4 or 5 tons capacity find McQuay Seasonmakers remarkably efficient.

McQuay Seasonmakers are designed for use with a hot or chilled central water supply system. Also available for refrigerant operation. Their 3-speed, quiet operation and the drain pan with closed cell insulation for protection against sweating and auxiliary drain pan to catch condensation from the control or shut-off valve are features you'll appreciate. In fact, you'll like everything about McQuay Seasonmakers! Contact your McQuay representative, or write to McQuay, Inc., 1601 Broadway Street N. E., Minneapolis 13, Minnesota.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION


WOOD'S NEW "SVS" DRIVES
WON'T FREEZE OR STICK...
NO LUBRICATION IS NEEDED
. . . because Wood's "SVS" Variable Speed Sheaves have positive locking collars which securely clamp sheave parts into place, eliminating fretting corrosion and freezing as well as the need for lubrication.
WOOD'S "SVS" DRIVES ARE
IN CAPACITIES FROM

Wood's stationary control, variable speed drives, including SVS types, are available in capacities from fractional to over 300 hp using conventional v-belts. Wide range VPS types are available in capacities from 1 to 20 hp.

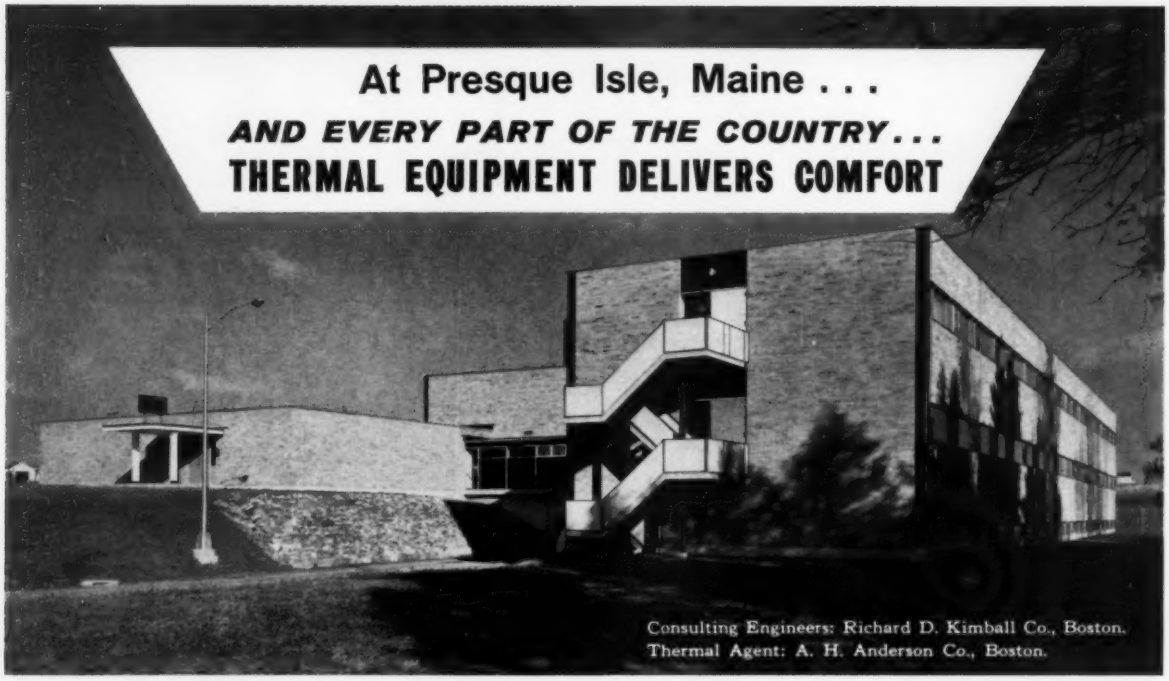
Write for BULLETIN 6102.

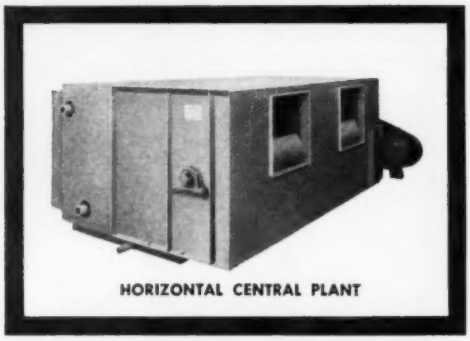
T. B. WOOD'S SONS COMPANY · CHAMBERSBURG, PENNSYLVANIA

ATLANTA · CAMBRIDGE · CHICAGO · CLEVELAND · DALLAS

Wood's

SVS/161


At Presque Isle, Maine . . .
AND EVERY PART OF THE COUNTRY . . .
THERMAL EQUIPMENT DELIVERS COMFORT
Consulting Engineers: Richard D. Kimball Co., Boston.
Thermal Agent: A. H. Anderson Co., Boston.


HORIZONTAL CENTRAL PLANT

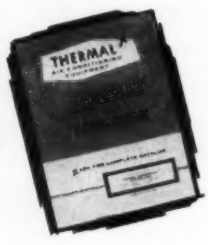
Gould Memorial Hospital in Presque Isle, Maine, uses Thermal units for its dependable air conditioning and ventilating system.

Used in a growing number of hospitals and all types of buildings, from air terminals to zoos, the quality and dependability of Thermal equipment brings comfort to occupants, satisfaction to owners, and confidence to architects and engineers.

The Thermal line of finer air conditioning and ventilating equipment is one of the most comprehensive on the market.

Complete details on Thermal equipment that you can specify with confidence are available.

New! Condensed 6 page, 2 color brochure briefly describes the Thermal line. Write for your copy.



A few of the other hospitals using Thermal equipment:

NAME	LOCATION
Henry County Hospital	Abbeville, Ala.
Jackson Hospital	Montgomery, Ala.
Park View Memorial Hospital	Arlington, Calif.
Jackson Memorial Hospital	Miami, Fla.
Mercy Hospital	Miami, Fla.
Cloverleaf Hospital	Miami, Fla.
Augustana Hospital	Chicago, Ill.
Cushing Memorial Hospital	Leavenworth, Kan.
Our Lady of the Lake Hospital	Baton Rouge, La.
Southern Baptist Hospital	New Orleans, La.
Van Buren Hospital	Van Buren, Maine
Medfield State Hospital	Medfield, Mass.
Midway Hospital	St. Paul, Minn.
Mounds Park Hospital	St. Paul, Minn.
Jefferson Davis Memorial Hospital	Natchez, Miss.
Cedar County Memorial Hospital	Eldorado Springs, Mo.
St. Elizabeth Hospital	Lincoln, Nebraska
Charlotte Memorial Hospital	Charlotte, N. C.
Lea County Hospital	Hobbs, New Mexico
Anadarko Hospital	Anadarko, Okla.
Haskell County Hospital	Stigler, Okla.
Hillcrest Memorial Hospital	Tulsa, Okla.
Columbia Hospital	Pittsburgh, Pa.
Roper Hospital	Charleston, S. C.
Spohn Hospital	Corpus Christi, Texas
Cook Memorial Hospital	Ft. Worth, Texas
Hermann Hospital	Houston, Texas
Memorial Hospital	Houston, Texas
Mercy Hospital	Houston, Texas
Tuberculosis Hospital	Houston, Texas
Institute for Rehabilitation & Research	Houston, Texas

(Plus a number of government operated hospitals)

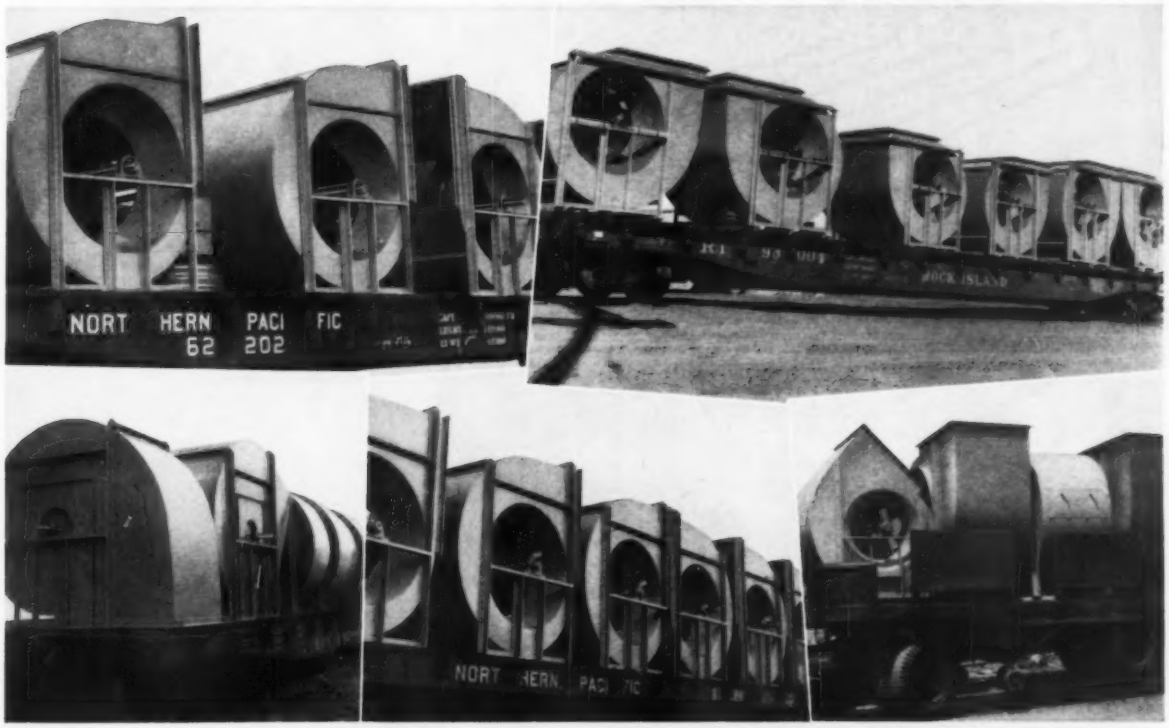
Quality Products Since 1945

THERMAL ENGINEERING CORPORATION

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

AGENTS IN PRINCIPAL CITIES

for your large air moving requirements . . .
CALL ON BARRY FOR THE BIG ONES!



BARRY
centrifugal fans are engineered to do the job *RIGHT!*

Yes, big air moving jobs can bring big headaches . . . unless your blower supplier can give you fast delivery on fans that will do the job right. That's where Barry's experience pays off for you!

Barry builds a lot of big fans, and Barry's know-how assures you of speedy delivery on every big blower project. And the same inherent precision, good design, perfect balance and overall attention that regularly goes into our smaller fans will also be found in our larger units.

Whenever you require big volume fan equipment—see your Barry representative. And even if your fan needs are not as large as the blowers shown here, your Barry representative can help you solve all your problems quickly and efficiently!

fast delivery too!—on fans in all classes from I to IV:—
check with BARRY first, you'll save time and money!

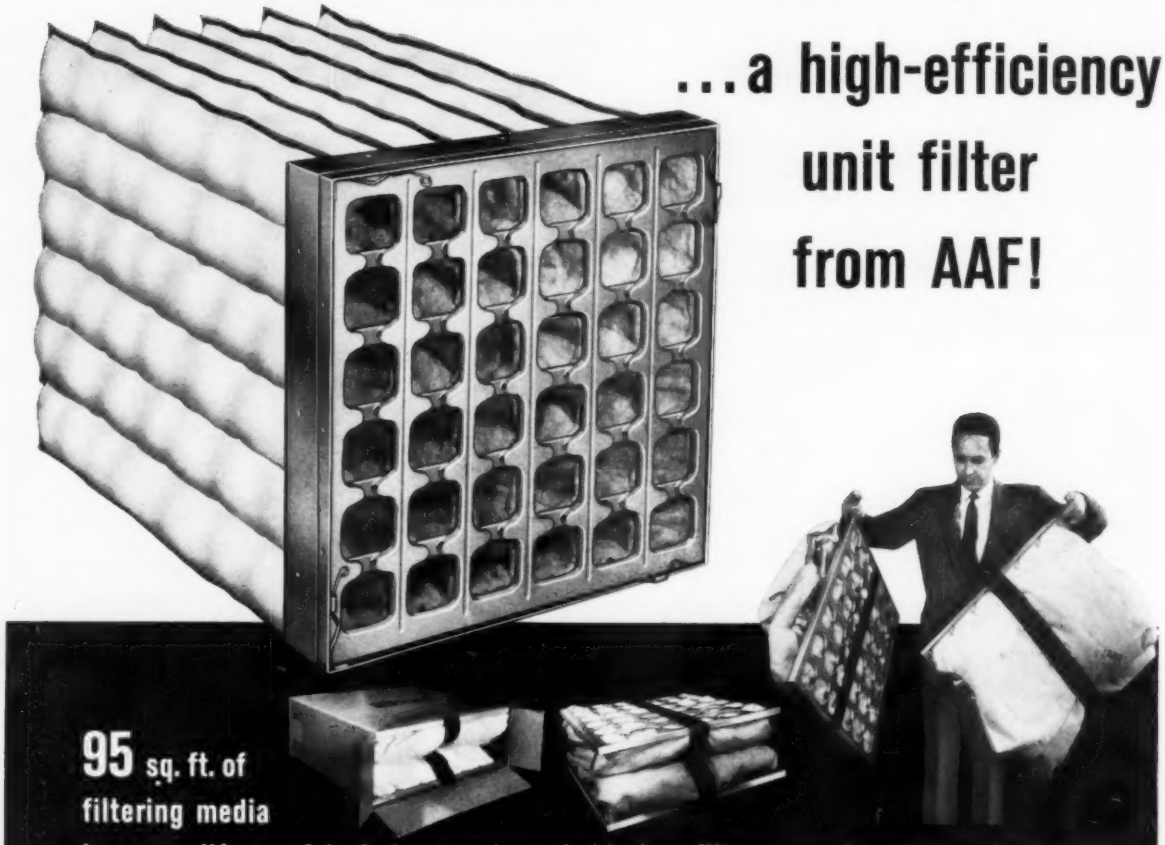
member of air moving and conditioning association inc.

BARRY BLOWER CO.
3100 CALIFORNIA ST. N. E., MINNEAPOLIS 18, MINN.

FC VENTILATING FANS • INDUCED DRAFT FANS • STEEL PLATE FANS • FAN WHEELS AND SCROLLS • BBC VENTILATION FANS • FORCED DRAFT FANS • FUME EXHAUST FANS • UTILITY EXHAUSTERS • BELTED VENTILATING SETS • MATERIAL HANDLING FANS • MEDIUM PRESSURE BLOWERS • SPECIAL APPLICATIONS

NEW! DRI-Pak SERIES 2000

...a high-efficiency unit filter from AAF!



95 sq. ft. of filtering media in one unit!..... 8-inch-deep carton...holds two filters...each weighing just 4 lbs.!

New dry-type unit offers unmatched combination of air filter advantages. AAF's new DRI-Pak Series 2000 air filter combines high efficiency, low resistance, compactness and large dust-holding capacity to a degree unequalled by any other dry-type unit filter.

The secret is in its unique "windsock" operation. The "tubes" of the glass fiber media inflate to a 36-inch depth when the system is in operation, but collapse when the system is shut down! This collapsing feature eliminates the need for rigid back-up wire grid and the possibility of damage to the cartridge during servicing.

Filter maintenance amounts to nothing more than infrequent replacement of the DRI-Pak cartridge. And the plenum for a bank of DRI-Pak filters need be very little deeper than the filter's 36-inch inflated depth because almost the total space can be used as access to washer, coils, etc., when the system is shut down.

The AAF DRI-Pak is available in 24" x 24" or 12" x 24" sizes.

For complete product information on the new DRI-Pak air filter, call your local AAF representative or write us direct for Bulletin No. 228. Address: Mr. Robert Moore, American Air Filter Company, Inc., 373 Central Avenue, Louisville, Kentucky.

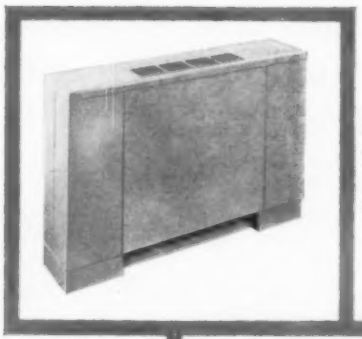
AAF American Air Filter

BETTER AIR IS OUR BUSINESS

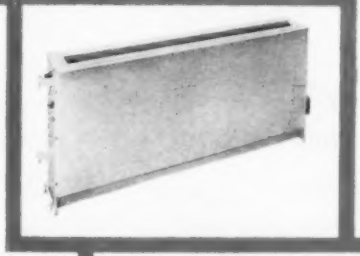
C'EST SI BON...

BOHN-AIRE

means COMFORT
in any language...
in any season!

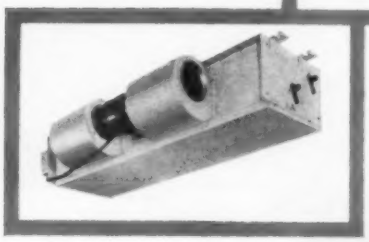


MODEL B-D for vertical floor mounting "in-the-space" or semi-recessed up to 3½".



MODEL B-V for vertical concealed floor mounting.

MODEL B-C with finished cabinet for "in-the-space" horizontal mounting.



MODEL B-H for horizontal mounting in concealed locations (plenum optional).

COMPLETE FLEXIBILITY... 4 ROOM CONDITIONERS IN 5 SIZES EACH

Quietly, dependably, BOHN-AIRE Remote Individual Room Conditioners provide year 'round comfort in apartments, motels, hotels, offices, hospitals... in any building with a central hydronic heating and cooling system. They are extremely compact with a slim 8½" width... available in concealed models or in attractive, durable cabinet styles... easy to install and service. Finger-tip push button control! Many optional accessories.

BOHN *Buy the known line... the BOHN line*
ALUMINUM & BRASS CORPORATION
Danville Division • Danville, Illinois

YARWAY news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD

YARWAY GUN-PAKT EXPANSION JOINTS ARE BEING SPECIFIED IN RECORD NUMBERS

These user-benefits tell why:

All over the country a rapidly-increasing number of expansion joint jobs on steam and high temperature water piping at utilities, industrial plants and institutions are being specified "YARWAY GUN-PAKT." Here's why:

TROUBLE-FREE SERVICE

Shutdowns are eliminated. Packing can be added *under full line pressure.* No vents. Joints never need repacking.

SIMPLIFIED DESIGN

Sectioned view (below) shows at a glance the simple, compact design. Provides easy accessibility, takes less space to install and maintain, needs smaller manholes, fewer joints per length of pipeline.

RUGGED DEPENDABILITY

All-steel construction, with durable, chromium-plated seamless steel sleeves. *No chance of metal fatigue.*

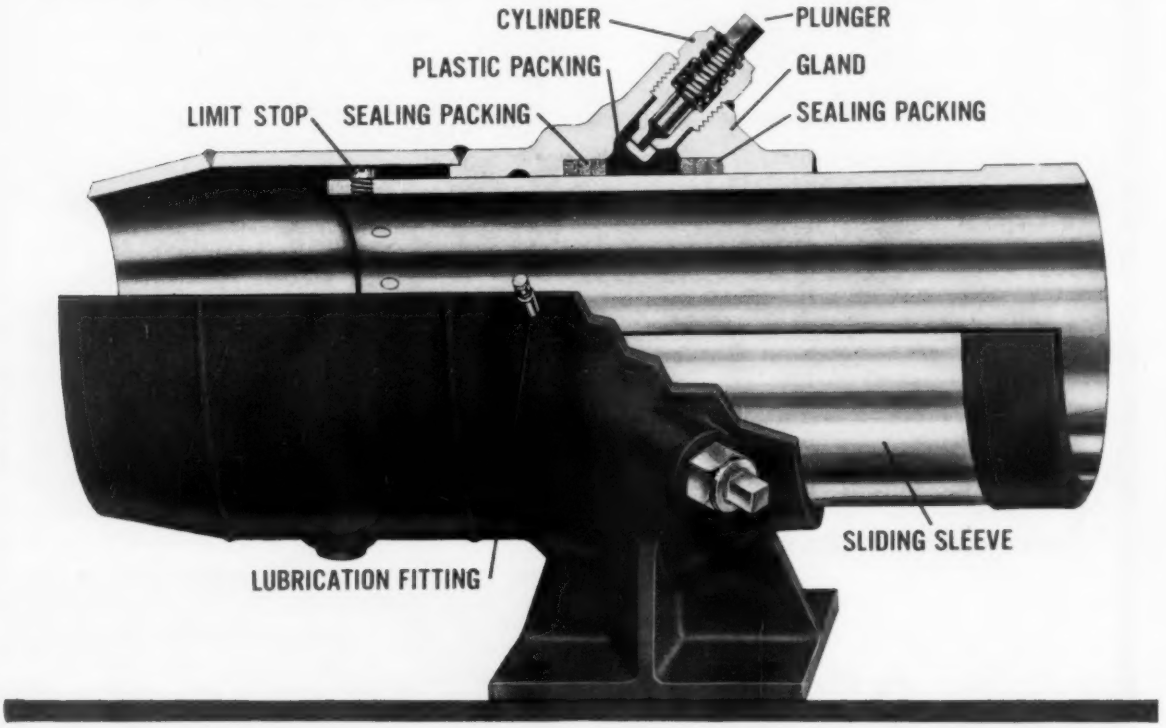
INTERNAL AND EXTERNAL GUIDES

Positive alignment of sleeve in stuffing box, *where it counts.*

MINIMUM MAINTENANCE

Never a shutdown for repacking—and records show an average of one manhour and 65 cents worth of packing added per joint per year. *Many Gun-Pakt Joints have been in service over 25 years with only this nominal maintenance.*

Why don't *you* investigate Yarway Gun-Pakt Joints by calling a Yarway Sales Engineer at one of the 20 Yarway offices located from coast-to-coast—or simply by writing for Bulletin EJ-1917.



LOOK TO POWELL VALVES

For the largest selection of valves, look to Powell. This includes gate, globe, angle and check designs in bronze, iron and steel, as well as industry's widest selection of special alloys. And, Powell valves are specifically designed for water, oil, gas, steam, air and corrosive fluid applications . . . whatever you need !

You can count on each Powell valve to be the result of the most complete engineering know-how and thorough testing procedures. These combine to produce valves of the highest reliability, and at the lowest cost . . . you save through Powell performance on your job.

In addition, you will find Powell maintains stock across the nation, near your need. So, your order is filled and delivered more quickly, at less trouble to you. For further information, contact your nearby Powell valve distributor or write The Wm. Powell Co., Cincinnati 22, Ohio.

150-pound Steel Gate Valve, Fig. 1503. Outside screw rising stem and yoke, bolted flanged bonnet, flanged ends. Accurately guided solid wedge disc and renewable seats. Sizes, ¼" through 30".

150-pound Steel Globe Valve, Fig. 1531. Outside screw rising stem, bolted flanged yoke-bonnet, flanged ends. Plug type guided disc, renewable seat. Sizes, ¼" through 12". Angle valves also available.

150-pound Steel Swing Check Valve, Fig. 1561A. Bolted Cap, flanged ends. This design makes possible full flow through when the disc is in the wide open position. Sizes, ½" through 16".

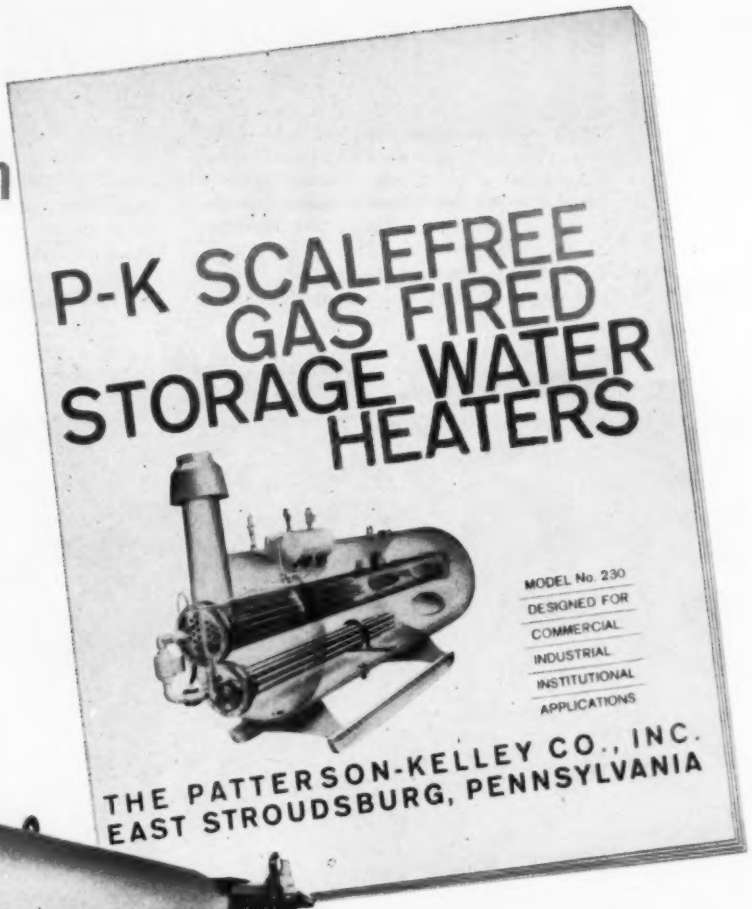
Powell Steel Valves are available for pressures from 150 through 2500 pounds; also with welding ends

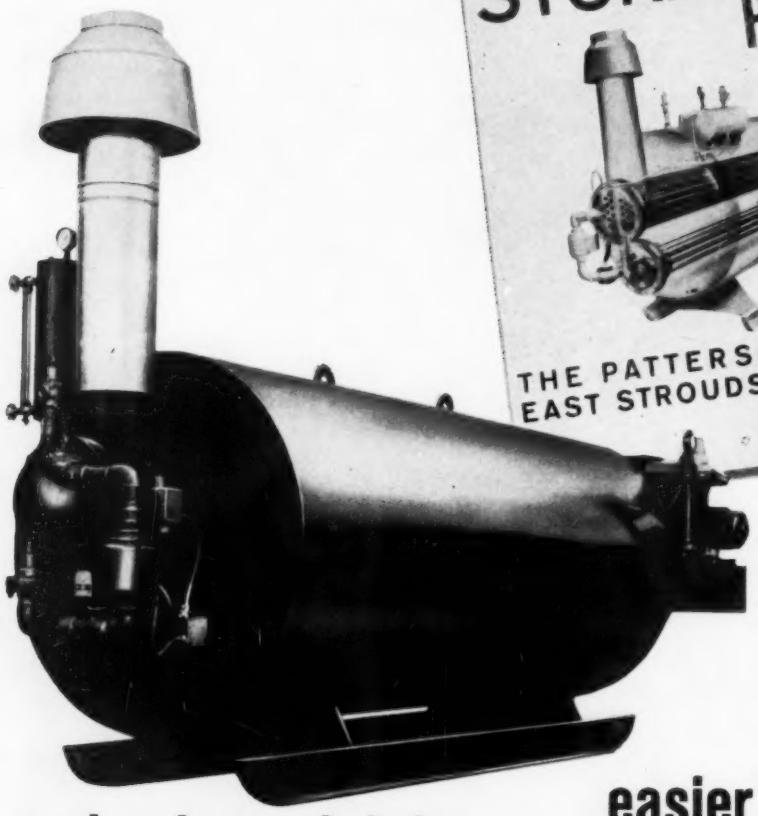
115th year of manufacturing industrial valves for the free world

POWELL STEEL VALVES

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

send for bulletin no. 4





easier to maintain

easier to install . . .

Striking new economies are now available for commercial, industrial and institutional buildings with P-K's SCALEFREE 230, the first indirect gas fired storage water heater • **Installation.** A complete and automatic package, P-K's SCALEFREE 230 can be skidded into place, hooked up and checked out quickly. There is no complicated piping or electrical work to run up costs. No stack is needed for extra draft. No foundation is necessary. Factory insulation (optional, as illustrated) further reduces costs and avoids the complications of on-the-site insulating. • **Maintenance.** P-K'S SCALEFREE 230 offers new freedom from trouble. It won't scale—and retains its rated efficiency—because heat transfer occurs below the temperature at which scaling minerals precipitate. Linings of Pre-Krete® or copper keep the storage section free of rust and corrosion regardless of water conditions. • P-K's SCALEFREE 230 is available in storage capacities from 250 to 4,000 gallons; recovery sections from 390,000 to 2,215,000 BTU. Bulletin No. 4 gives complete engineering and performance data. Address your request to: The Patterson Kelley Co., Inc., 33 Morgan Avenue, East Stroudsburg, Pennsylvania.

Patterson Kelley
Water Heater Division

3 good reasons for specifying the NEW

Fairbanks Morse SPLIT CASE PUMP

1

CASING WEARING RINGS:

Maintain high pump efficiency, minimize recirculation past the impeller rim; rings easily replaced when waterborne particles cause wear.

2

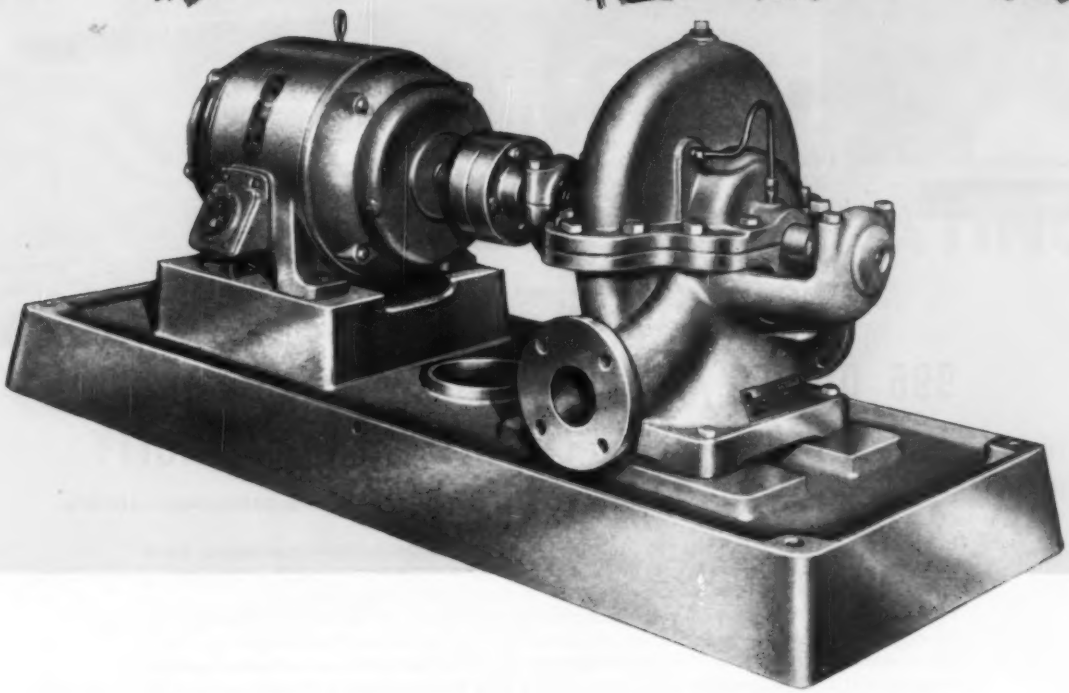
MAINTENANCE-FREE OPERATION:

Sealed pre-lubricated bearings require no checking, no lubrication service.

3

SHAFT SEALS OR PACKING:

Optional construction, factory supplied or field conversion, to suit pumping requirements, either mechanical shaft seals or conventional ring-type packing.



A brand new design . . . a brand new simplified concept in Split-Case Pumps. By far, your best buy. Single stage, horizontal Split-Case Centrifugal Pumps—a wise choice for chilled water, circulating or booster duty —cooling towers or general water supply, designed and supplied to you at moderate cost. For further information and factual bulletin #5820, write: **Pump & Hydraulic Div.; Fairbanks, Morse & Co.; Kansas City, Kan.**

FAIRBANKS MORSE

A MAJOR INDUSTRIAL COMPONENT OF

FAIRBANKS WHITNEY

Impressive main entrance to Chicago's Exposition Center, magnificent new mecca for exhibitors and conventioneers. Inset, right, shows one arrangement of the many Dorex filters.

996 DOREX AIR RECOVERY FILTERS SAVE 800 TONS OF AIR CONDITIONING CAPACITY

. . . and provide relief from the irritant-heavy atmosphere of shows, conventions, exhibits

In the new 34 million dollar Exposition Center at McCormick Place, 996 high efficiency Dorex activated carbon filters—the largest installation of its kind in the world—purge recirculated air of irritants and purify it for sanitary re-use in the Center's vast air conditioning system.

But from the Center's profitable-operation point of view, Dorex air recovery is even more important. Serving 350,000 square feet of exhibition space, the filter system will have almost one million cfm recirculated through it . . . representing a saving of 800 tons of air conditioning capacity at an installed cost of approximately $360 per ton, for a total saving of over $300,000! And further tremendous savings in operating costs will be realized!

Thirty years of research, development, and application, plus a systematic replacement service that ensures the continuous effective operation of every installation, make Dorex the best method of AIR RECOVERY and ODOR CONTROL.

Representatives in principal cities.
Write for detailed information.

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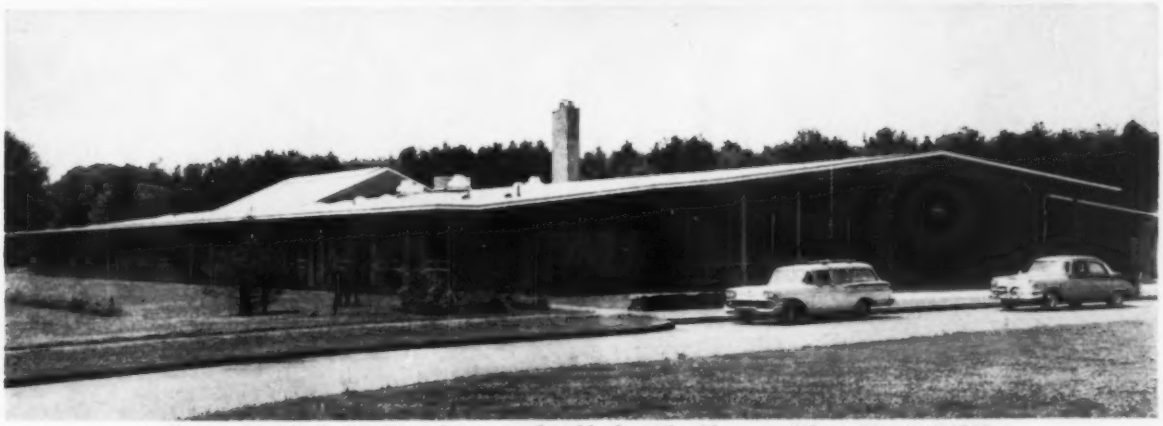
dorex® air recovery

. . . the most experienced professionals in air recovery and purification.

Campbell

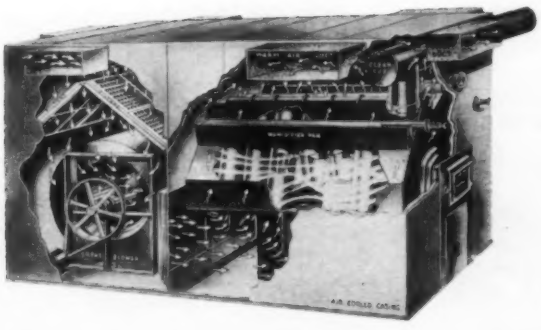
WARM AIR HEATERS FOR LARGE BUILDINGS



Elementary School, Hamilton, Mass., comfortably heated with two oil-fired Campbell 8000 Series Heaters. Architect, Hugh A. Stubbins Associates, Inc.; Engineer, Fred S. Dubin, Associates.

TOP VALUE IN SCHOOL HEATING

Campbell Heaters provide extra value in all the factors that are important in school heating. They combine all the natural advantages of warm air heating: control of temperature, humidity and ventilation; plus quiet operation and the ability to deliver quick abundant heat with exceptional fuel economy. Campbell Heaters are moderately priced, easy to install, and deliver long, dependable service. Your inquiry will receive prompt attention.



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We have some attractive openings for men calling on heating contractors and architects.

CAMPBELL HEATING COMPANY

DES MOINES 17, IOWA

Every 7 seconds . . .

Lapsed time between OIC installations is being reduced month by month. More and more maintenance men know they can count on trouble-free operation when they replace worn out valves with OIC. Performance-proven design features include stems made from special OIC Alloy 40 on bronze valves. Result . . . seizing completely eliminated . . . corrosion minimized . . . wear greatly reduced. OIC stems will outlast ordinary valve stems 10 to 20 times. Your local OIC distributor carries a complete line of bronze and iron gates, globes, angles and checks. Call or write today for further information.

BETTER VALVES AND BETTER DISTRIBUTOR SERVICE FROM OIC

someone . . . somewhere . . . installs another OIC valve!

OIC VALVES

BRONZE, IRON, FORGED STEEL, CAST STEEL AND DUCTILE IRON VALVES

INDUSTRIAL DISTRIBUTORS SERVING INDUSTRY ECONOMICALLY THE RIGHT HAND OF PRODUCTION

THE OHIO INJECTOR COMPANY, WADSWORTH, OHIO

THE OHIO INJECTOR COMPANY 10231-OIC

235 Main St., Wadsworth, Ohio

I need more information about OIC bronze and iron valves.

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EVERY B&G® COMPONENT IN THIS TYPICAL INSTALLATION IS ALIVE WITH STAR FEATURES

B&G CONDENSERS

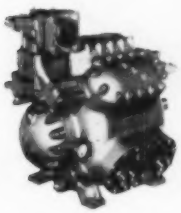
Lighter, more compact units, featuring quiet, vibration-free operation, uniform gas distribution, cleanable tubes and higher operating efficiencies.

B&G EVAPORATORS

See illustration at right for features which give these units outstanding superiority.

B&G SUCTION LINE HEAT EXCHANGERS

Aid thermal expansion valve operation, prevent liquid slugging.

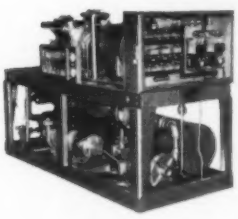


B&G COMPRESSORS

Precisely engineered for vibration-free operation with all the advantages of "open" units. All units have *one* bore —a few interchangeable parts service them all.

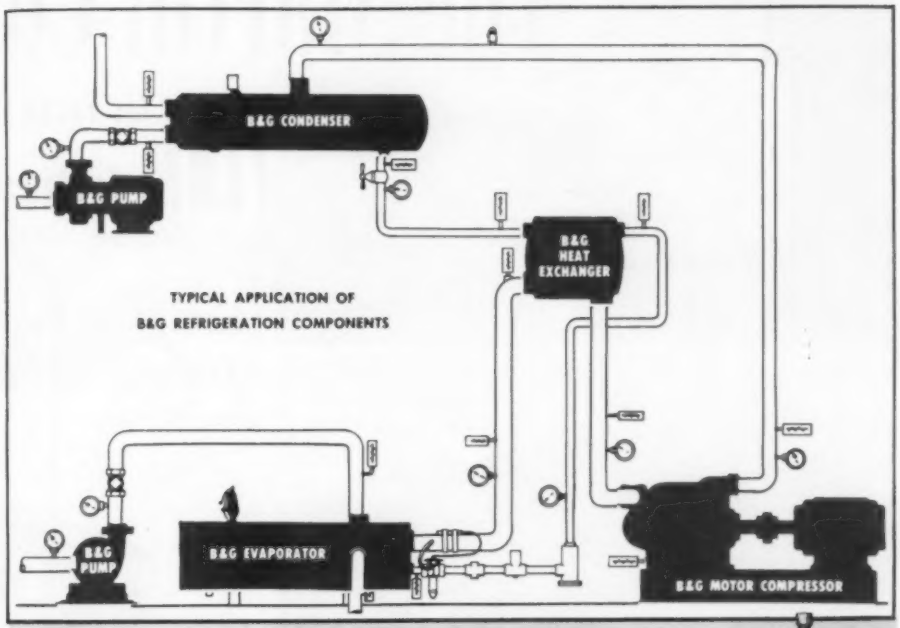
B&G CENTRIFUGAL PUMPS

A full range of *quiet* pumps for refrigeration and air conditioning systems.



B&G PACKAGE LIQUID COOLERS

A completely integrated and assembled water chiller—the only unit of its kind with all major parts designed, built and guaranteed by one manufacturer.



"REF" EVAPORATOR...Featuring non-slugging design...tube bundle proof against freeze-up damage...positive oil return.

SERRATED TUBE HOLES Assure leak-free joints between tube sheet and tubes

SPECIAL DESIGN COPPER TUBING

Fluted tubing provides positive and permanent mechanical bond between tube and inner fin for all temperature variations—positive contact throughout 180° bend. Inner-fin tube triples refrigerant heat transfer surfaces. Centrifugal force created by the twisted spline holds liquid refrigerant against tube, minimizing slugging and pressure drop.

B&G makes a complete line of refrigeration and air conditioning components—*with many commonly used sizes available for immediate shipment from factory stock!*

These are quality units throughout! B&G Evaporators and Condensers all offer *plus values* in efficiency and rugged, long-life construction. They are manufactured by methods which hold shell diameters exact and free of distortion. This permits tight fitting baffles with minimum liquid slippage, greater efficiency and easy replacement of tube bundles if ever necessary.

All units are built to A.S.M.E. Code requirements and are so stamped.

When selecting pumps, B&G Series 1522, 1531 and 1510-B Centrifugal Pumps invite your most critical comparison. They are of vertical split case design, equipped with the exclusive, leak-proof "Remite®" Mechanical Seal and noted for quiet, dependable operation.

BELL & GOSSETT
COMPANY
Dept. RGO-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

The Martin Company

The U. S. Air Force TITAN Vertical Test Facility

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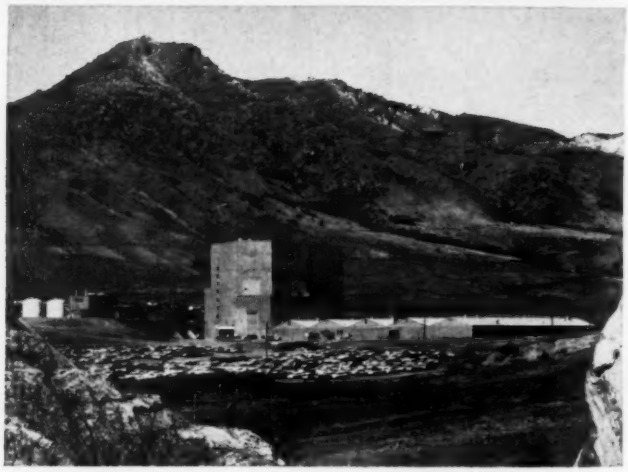
Complete Facilities for Simulated-Flight Testing



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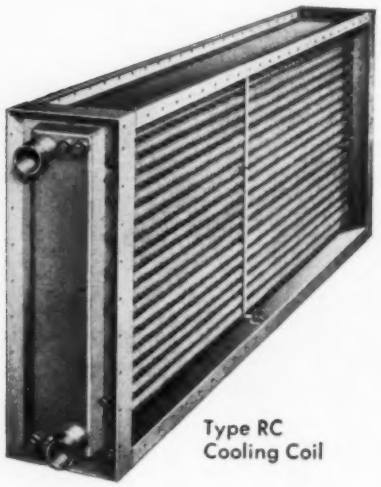
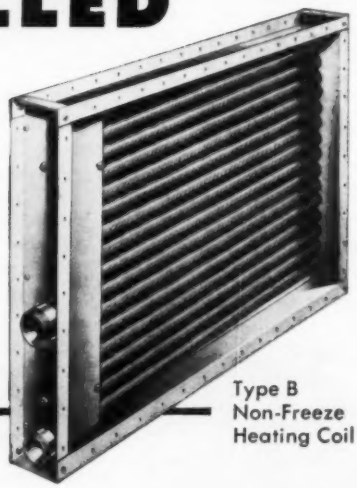


Type RC
Cooling Coil

AEROFIN INSTALLED

Modern smooth-fin design of Aerofin coils permits ample heat-exchange capacity in limited space — permits the use of high air velocities without turbulence or excessive resistance.

Aerofin performance data are laboratory and field proved. You can safely specify Aerofin coils at full published ratings.



Type B
Non-Freeze
Heating Coil

AEROFIN CORPORATION

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Aerofin is sold only by manufacturers of fan system apparatus. List on request.

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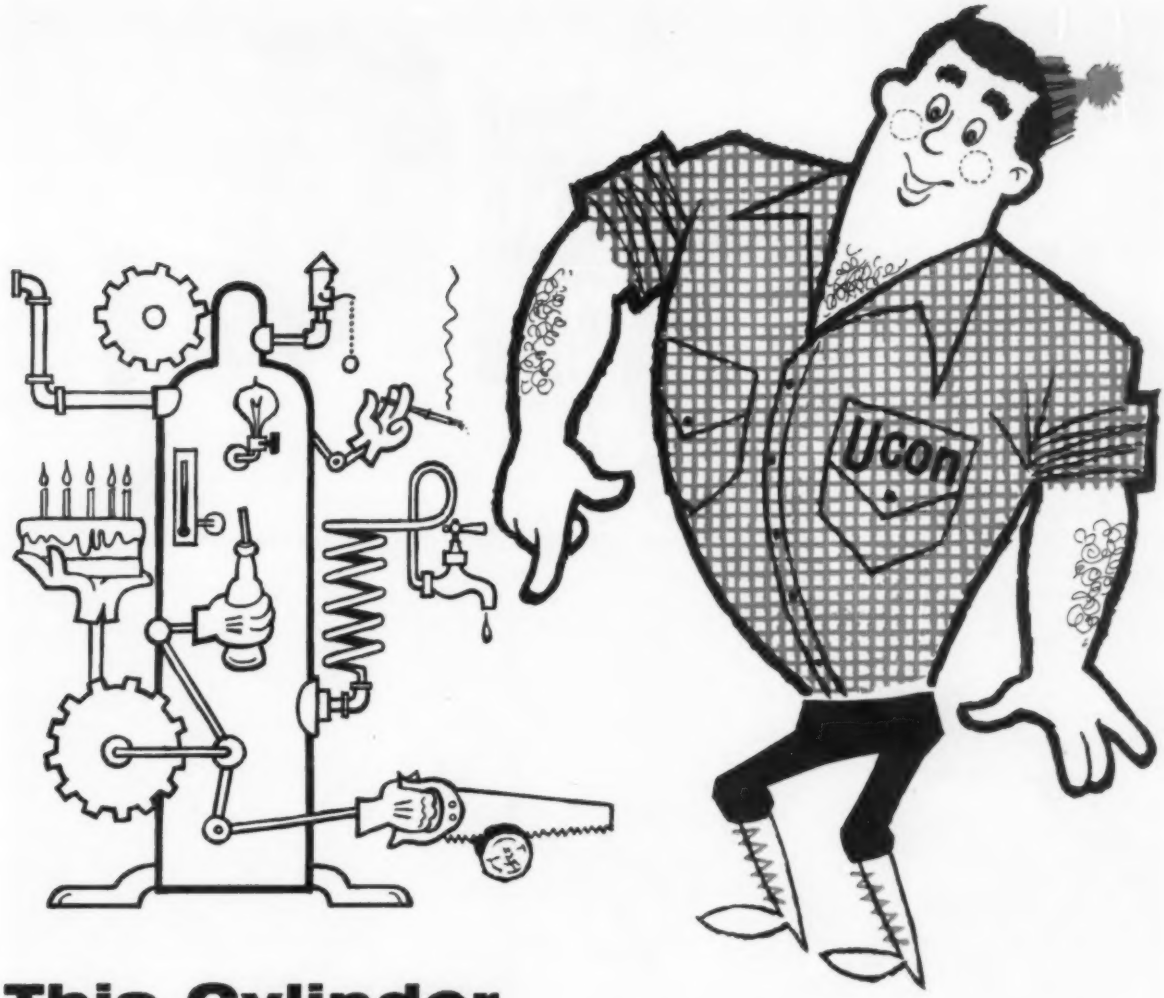
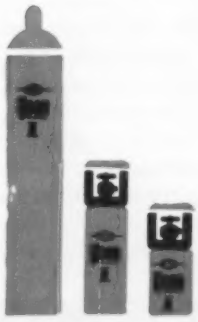


This Cylinder Does Everything...

. . . stands right side up, upside down, discharges top, bottom and middle, carries itself, heats soup, grinds nuts, and transports you to and from the customer via a detachable propulsion system. Available in 27 sizes, it's the perfect answer to your every oddball requirement.



But for every day THESE THREE WILL SUFFICE . . .

Make no mistake about it—by SUFFICE, we mean cover the ball park. In one . . . two . . . *three* UCON® Refrigerant Cylinders you'll find every important packaging convenience, every cylinder size you need, *and*—you can always be sure your wholesaler will have what you need, *when you need it*. Helpful technical assistance, too, is yours for the asking with UCON Refrigerants. Conclusion:

For the most compact and convenient line of refrigerants—
See Your UCON *Refrigerants Wholesaler*

UNION CARBIDE product **Ucon®** refrigerants — exclusive sales agent **ANSUL**

UCON Refrigerants are manufactured by
UNION CARBIDE CHEMICALS COMPANY— Division of Union Carbide Corporation
270 Park Avenue, New York 17, N. Y.

Exclusive Sales Agent to Air Conditioning and Refrigeration Wholesalers
ANSUL CHEMICAL COMPANY, Marinette, Wisconsin

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The confident gentleman. He knows Typhoon units are loaded with features that assure satisfaction. As for the other gentleman, he'll know better next time—if there is a next time. With the addition of 28 new units to its 1961 line, Typhoon offers the industry's broadest, biggest, most versatile group of packaged air conditioners, furnaces and heat pumps. Typhoon economy begins with its mass produced components, which can be custom-assembled to your order to meet any unusual requirement... **at little or no extra cost.** Typhoon quality begins with Power Reserve—superior components and oversize parts to deliver beyond rated capacities. Each Typhoon unit is built to take extreme weather conditions and sudden severe temperature changes without strain or breakdown. The 28 new units include nine heat pumps, three air handlers, three air cooled remote condensing units, three air cooled condensers, and ten self-contained package units. **For complete satisfaction,** specify Typhoon. It suits every need in air or water cooled units; ceiling, floor or roof mounted units; units that heat and cool or cool only—in capacities from 3 to 75 tons. Write today for complete product literature.

Air Cooled Self-Contained
Units 3 to 30 Tons

TYPHOON
HUPP

TYPHOON AIR CONDITIONING DIVISION, HUPP CORPORATION 8-3-1
505 Carroll Street, Brooklyn 15, New York

☐ Please send me full product literature on Typhoon's 1961 Line.
☐ Please have a representative call for an appointment.

NAME_____

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VIRGINIA Chemicals

REFRIGERATION BULLETIN

Facts about water system maintenance

TIPS ON CLEANING TOWERS AND EVAPORATIVE CONDENSERS

Costly emergency repairs during a busy season can be prevented by proper application of water chemicals at startup and shutdown time. Two basic steps are important. First, remove all dirt, scale and algae; second, retard corrosion and recurrence of scale with "Virginia" Corrosion Inhibitor. Follow a specific program to prolong equipment life and maintain maximum operating efficiency.

Cleaning Procedure

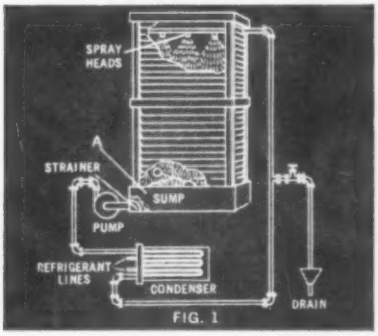

FIG. 1

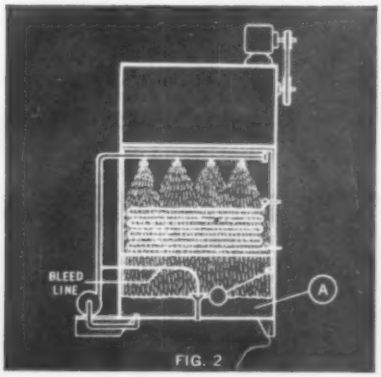

FIG. 2

(1) Drain and flush out loose dirt from sump. This consumes and wastes cleaner. *This is important.*

(2) Close bleed and refill with fresh water.

(3) Estimate gallons of water in the system. Then add first dosage of solid or liquid scale remover as follows:

"Virginia" Scale Remover—Solid . . .
5 lb. per 10 gal. water

"Virginia" Scale Remover—Liquid . . .
1 gal. per 15 gal. water

In natural draft cooling towers and in evaporative condensers, the chemical can be added at the sump (as in Figs. 1 & 2). In forced draft towers it can be added at the tower distribution plate, tank or sump.

(4) Operate system as usual. Check the scale remover solution strength in the sump every 10-15 min. with test papers. If paper does not turn *red* when immersed, add more cleaner until it does. Lowered head pressure will indicate when unit is clean—or simply inspect the tubes of the evaporative condenser. Inspecting the water outlet pipe of shell and tube condensers will tell you the scale condition of this type of unit.

(5) After scale removal, drain the solution into the sewer. Rinse the system twice with fresh water.

Scale Prevention

Following the cleaning procedure, apply "Virginia" Scale & Corrosion Inhibitor in the following steps:

(1) Adjust bleed rate according to table below.

(2) Use 2 lb. Inhibitor per 10 tons' capacity for soft water. Triple this amount for hard water. Use a shallow wire mesh basket for crystals. Place in the sump.

(3) Repeat ⅔ of this dosage after a 90-day period.

Make-up water hardness (parts per million)	100-199	200-299	300-up
Bleed rate in gal. per hr. per 10 tons	9	18	36

How to clean shell and tube—coil condensers

Isolate the condenser from the cooling tower by valves or by actually disconnecting its piping. Prepare a strong cleaner solution in a large plastic pail or wooden tub. Dissolve 5 lb. of solid scale remover in 10 gal. of water—or add 1 gal. of liquid cleaner to 15 gal. of water. Circulate this solution through the condenser by using a pump, as in Fig. 3. Cleaning moderately scaled units should take about one hour. Test the solution regularly with test papers. Add more cleaner as needed. After cleaning, empty and flush the condenser at least twice and then replace it in the system.

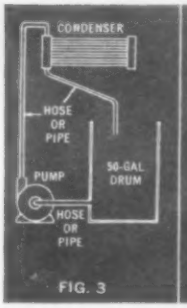

FIG. 3

FIG. 4

To open up condensers completely clogged with scale, use standpipes (see Fig. 4). Mix liquid cleaner and water in equal proportions. Fill the pipes to a level above the condenser. Protect surrounding objects from being injured by any foaming that may occur. After cleaning, drain the spent solution. Rinse condenser twice with fresh water.

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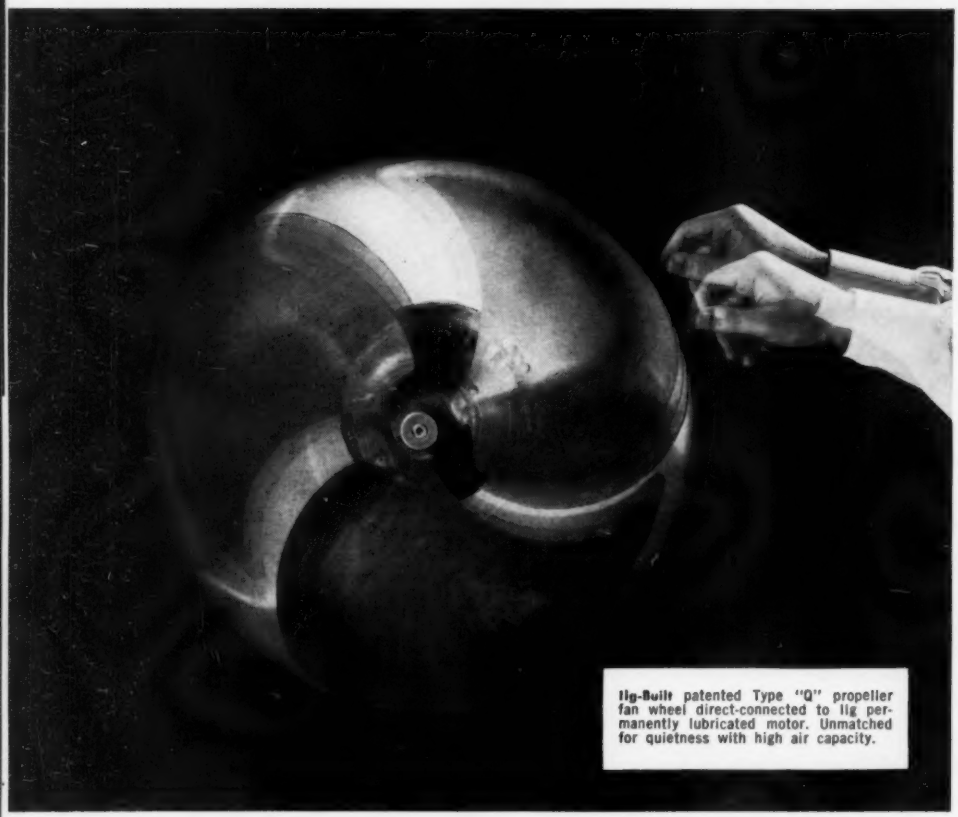

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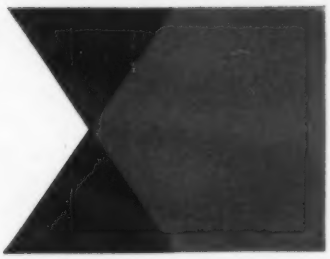


"Open for Discussion"

Some Added Thoughts on Increased Boiler Corrosion at High Temperature

I WOULD LIKE to expand my answer to the question, *Will Higher Boiler Temperature Cause Corrosion, Other Problems?* in the February issue.

In order to answer the question more completely regarding an increased demand on an existing hot water system supplying both domestic hot water and heat to an apartment building, and the effect of corrosion on the systems that might be experienced by increasing the boiler water temperature, I feel it is necessary to make some qualifications to the conditions in replying.

The closed hot water circuit will certainly carry more heating capacity if the temperature of the water in the circuit is raised from 190 to 210 F. This would increase the heating capacity of the existing coils in the domestic storage tank; assuming, of course, that the boiler is capable of meeting the additional demand.

In the closed circulating hot water circuit, assuming that it is properly installed to where there is no air intake and only negligible raw water makeup, there should be no problem of increased corrosion because of increased boiler water temperature. This fact has been satisfactorily substantiated by Don Gardner of the Bell & Gossett Co. in his recent publication concerning closed hot water circuits.

If the increased domestic hot water demand is the problem, and it appears to be, there is certainly a problem of more corrosion because of handling and heating more raw water. Since the temperature of the hot water supplied by the domestic system would remain effectively the same, there would appear no great increase likely in the corrosion rate in the average system. However, since the temperature of the water in the tube bundle would be higher if the boiler water temperature was raised, the water in the tank immediately surrounding the tube bundle would be somewhat higher, and if this exceeded 180 F, the corrosion action might effectively become higher. This is especially true in localities where service water is noted to be highly corrosive in nature and corrosion problems are major.

Assuming this to be the case, a larger heating coil in the tank or an additional tank and heater would appear to be the better solution rather than raising the boiler water temperature. This conclusion would meet the basic demand of increased load rather than enhancing the possibilities of increased corrosion in the domestic hot water system.

A. J. BEALL, JR.
Beall & Associates
Engineering Consultants

Replies to Criticism of Campus Type School Plan

MR. CLARKE'S letter of comment in the "Open for Discussion" pages in the February issue on the article *Double Loop Steam System Heats High School Campus* (December) would be very much to the point were it not that several factors, of which he could have no knowledge, entered into the decision to build the type of school that was ultimately constructed.

I have worked with the architects for this project many years and as is customary with them, was called in early in the sketch stage to advise them. Three different schemes were developed to a point where the advantages and disadvantages could be reviewed, and preliminary figures on cost and maintenance estimated. One of these was the conventional box type so highly thought of in the Readers Digest article mentioned by Mr. Clarke.

The School Board decided in the end, after reviewing the data presented, that the campus type was the plan that best suited their needs and the architects were instructed to develop these sketches. The Board visited various schools of all types, not only in this district, but in other cities before making their decision. The Superintendent of Schools presented the Board's views as well as his own, in

"Open for Discussion"

Continued

an article for the community which was very well received. In this case there was no high pressure selling by a "fast talking architect." We act as consultants to several architects and I assure Mr. Clarke that fast talking is not the rule.

The statement that 30,000 lb of steam per hr is required to serve the project is misleading as the article clearly states that 24,000 lb boilers were installed for the ultimate capacity and that the 30,000 lb per hr was developed on an acceptance test.

ELWOOD S. TOWER
Registered Engineer

Questions Heat Transfer Effects In One-Pipe Brine Distribution System

I WOULD LIKE to comment on the article, *Proposed: A One-Pipe Brine Distribution System*, by Herman Vetter in the January issue.

The use of partial or full series flow through the calenders, instead of parallel flow seems to have advantages. The main ones apparent to me are:

1) The one mentioned by the author, that the rate of flow through the heat exchanger will remain nearly constant at all times.

2) A high velocity through a calender may be obtained by circulating less total brine at a higher pressure difference. The lower circulation means a smaller pump and piping. The effect on the pump horsepower would not be known without a more complete knowledge of exactly what is to be done.

3) The series circuit requires less length of piping.

The statement is made that the one-pipe distribution is better because the flow through one calender can be changed without affecting the flow to the other units. However, with the one-pipe distribution, if the flow through any unit but the last is increased, the temperature of the brine to the following units is increased. Presumably, increasing the flow to the last unit will not affect the temperature to the first because the heat exchanger intervenes and the brine temperature leaving the exchanger is probably controlled by governing its heat removal capacity.

Without knowing more of the details of an actual system, it is hard to say whether the flow rate or temperature of the brine has the greatest effect. With brine temperatures of 10 F to 15 F and a web temperature of 40 F, the extremes of difference in temperature causing heat-transfer are 30 F and 25 F. Thus, whether it is one or the other, the percentage of change is small. If instead, a surface was kept at 20 F with 10 F to 15 F brine, the extremes of difference are 10 F and 5 F. In one case the greatest variation is 6 to 5; the other 2 to 1.

I believe that the tables and the discussion pertaining to them, give an unintended impression that this one-pipe distribution permits more heat to be transferred with less total brine flow.

In the case of Fig. 1, the heat removed from the calender is given at 3025 Btu per sq ft per hr with 27.5 F average temperature difference and this heat raises 25 gpm from 10 F to 15 F. In Tables 1 and 2. 4040 to 4760 Btu per sq ft per hr is removed, but this raises 50 gpm only 0.5 F. The heat removal rate has increased 32 to 53 percent, but the amount given to the brine (as indicated by the gpm and temperature difference of the brine) has decreased 80 percent, being only 1/5 as much.

In Table 3, the heat removed from the calenders is given as 5050 to 5950 Btu per sq ft per hr or 66 to 94 percent more, but the heat given to the brine is 60 percent less (100 gpm raised 0.5 F), when compared to the original circuit figures.

The heat removal, from all calenders, resulted

1) In the first case, in raising 250 gpm from 10 F to 15 F.

2) In the second case, in raising 50 gpm from 10 F to 15 F.

3) In the third case, in raising 100 gpm from 10 F to 15 F.

As I have previously indicated, a one-pipe distribution system then may have certain advantages. However, if less brine is circulated but more heat is transferred, the brine temperature difference must be larger. Only with complete data and a thorough knowledge of the requirements and tolerances, can a definite decision be made as to which circuit is the better for a particular job.

M. A. RAMSEY
Consulting Engineer
Air Conditioning Division
Worthington Corp.

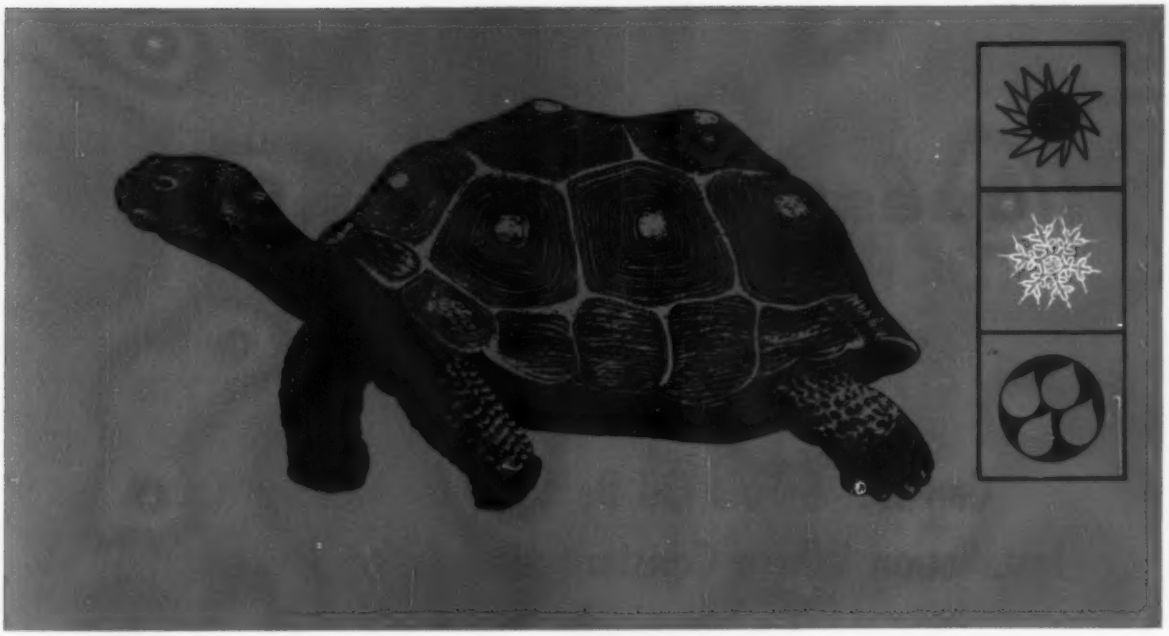
THE AUTHOR'S REPLY—It was not my intention in my article to suggest a means of using smaller pipe lines. The tendency too often is to use small pipe lines which we have found by experience to be a very serious mistake.

With reference to point No. 2 in Mr. Ramsey's comments, I cannot agree with the reason given here about circulating a smaller quantity of fluid. To do so would increase the temperature range between the inlet and outlet.

It was not my intention to imply that more heat can be transferred with less brine flow. I thought that it was clearly stated that there was no change in the quantity of fluid flow.

It is my desire to arouse interest in a possible improvement through this article.

HERMAN VETTER
Vetter Engineering Co.
Industrial Consulting Engineers
(*Continued on page* 205)



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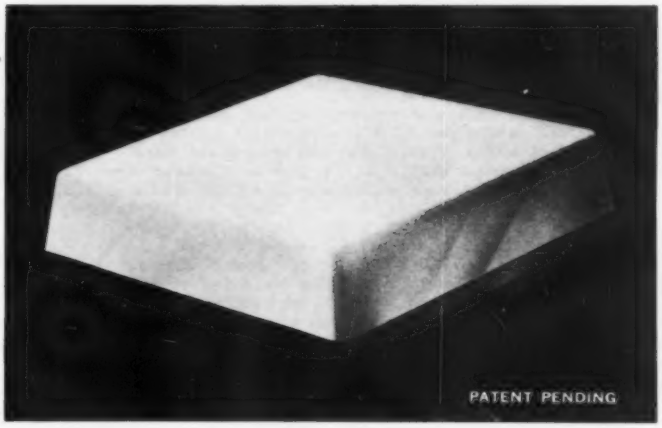

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question of the month

"Can No. 6 Fuel Oil Be Used for Heating Large Installation Where Constant Modulation Is Required?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with three answers that have been received from readers. Other solutions or comments for publication are invited.

"I am preparing a design for a new heating system for our plant, and will use unit heaters and convectors with hot water at a pressure of 50 psi and temperature of 300 F.

"The estimated capacity required will be 10 million Btu per hr. It is proposed to use two oil fired boilers of equal size, with a combined output of 12 million Btu per hr. The fuel being considered is a No. 6 fuel oil, with a viscosity of 3500 Saybolt seconds.

"The burners will have to be modulated constantly to satisfy the variable heating load, and I am wondering if it is wise to consider such a heavy oil for this purpose. I realize that No. 6 fuel oil will require preheating prior to combustion, but the operating cost with No. 6 oil will be considerably lower than with lighter fuels.

"I would like to hear from other readers of Heating, Piping & Air Conditioning about this and learn what their experiences have been with No. 6 fuel oil for large installations of this type." — R.A.W.

Should Be Satisfactory With Proper Preheating, Good Burners, Auxiliaries

IN REPLY to R.A.W.'s question *"Can No. 6 fuel oil be used for heating a large installation where constant modification is required?"* yes, this is possible.

He does not state his minimum load conditions but a 5 to 1 turndown is possible with No. 6 fuel oil with preheating and good burners and auxiliaries. He plans to use two boilers with a combined output of 12 million Btu per hr. With a 5 to 1 turndown each boiler would have an output of 1,200,000 Btu per hr.

The No. 6 fuel oil should be preheated to at least 205 F and fired with pressure atomizing type burners between 450 to 600 psig with proper burner nozzles for these conditions. R.A.W. should have no trouble modulating the fire to meet load demands in the above mentioned turndown ranges.

In order to provide a modulating control for this type equipment it should be accomplished only with automatic controls and instruments which are precise in their operation.

I have seen a high temperature hot water boiler with a capacity of 6 million Btu per hr fired on No. 6 fuel oil. I witnessed this boiler operating very smoothly at 1,200,000 Btu per hr output. The burners were pressure atomizing type and the fuel oil was fired at 450 psig at approximately 210 F.

The controls used a master pressure sensing element in the steam pressurized expansion tank, with flow meters on the high temperature hot water distribution system on both the supply and the return. The boiler was equipped with a forced draft fan which was designed to purge the boiler and fire-box before the burner pilot was ignited.

The fuel oil storage underground tank was provided with a heating coil around the pump suction and the return discharged into the tank near the suction line. From here the oil was pumped to the fuel oil preheaters where the pressure and temperature were boosted. The oil from the tank was received at the preheaters at approximately 120 F. The fuel oil was pumped direct to the burners from the preheaters at 210 F and 450 psig.

If R.A.W.'s minimum load will be less than a 5

Continued on page 84

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5415

question of the month

Continued

to 1 turndown on one boiler then he might be wise to consider two boilers of different capacities; perhaps one 4 million Btu per hr output and one 8 million Btu per hr output. This would allow more flexibility at low loads. The minimum low load would be about 800,000 Btu per hr on the smaller unit and about 1,600,000 Btu per hr on the larger unit.

I suggest that R.A.W. take another look at his variable heating load. He may find that it is possible to arrive at a closer balanced load by different distribution or by different grouping. This would cut down the amount of modulation. Possibly he could use some of the high temperature hot water to make some process steam which would also help to stabilize load conditions.

SHELDON R. HIGGINS
Mechanical Engineer

Cites Own Experience With Fuel, Notes Particular Design Suggestions

IN OUR AREA of the Pacific Northwest, No. 6 fuel oil is fired in many plants over 100 hp, which employ an operator. No. 6 oil is approximately 18 percent less expensive than No. 5 oil.

The system our office has found simplest, and most reliable, is the pumped fuel oil loop, at low pressure, with steam or hot water and electric oil heaters in series. The tank is limited in capacity to approximately 6000 gal and includes a hotwell, surrounding the suction pipe, to receive the recirculated oil. Each burner is equipped with an electric, low watt density, nozzle line heater.

The primary oil circulating pump is selected to pump not less than twice the nozzle(s) firing rate and is generally installed in duplicate. This pump is planned to operate continuously. The steam or water and electric heaters are selected for the particular type of burner which is to be employed, and are arranged in series with the steam or water heater preceding the electric heater. This arrangement allows a minimum of electric power consumption. The heaters are usually valved and by-passed for easy maintenance. Depending on the valving, pressure relief valve(s) are installed, to protect the oil side of the equipment.

The primary circuit pressure is maintained by a pressure regulating valve following the furthest oil burner suction side connection. The pressure can be set to suit the burners used and will depend on whether the burner includes both a primary pump and oil metering arrangement or only an oil metering arrangement. The return lines from the burners connect into the fuel oil loop downstream from the pressure regulating valve.

This system has been employed on many projects and performs most satisfactorily.

We do not see the connection between the particular design of the system proposed and the firing of No. 6 fuel oil and therefore have no comment on this point.

D. B. LEANEY
D. W. Thomson & Co., Ltd.
Consulting Mechanical Engineers

Tells Poor Action on Larger Boilers Requiring Switch to Lighter Fuel

IN ANSWER to the inquiry regarding burning No. 6 fuel oil for a HTHW boiler of about 5 to 6 million Btu per hr output, here at Colorado College we have two boilers of 20 million Btu per hr output each. The system was designed for firing of gas with No. 6 fuel oil standby, with complete combustion control. All equipment, such as heaters, pumps, burner tips, etc., were installed to meet No. 6 fuel oil requirements.

Without going into minute detail, we found that the equipment installed in the plant would handle the No. 6 fuel oil very easily, but we had trouble in obtaining complete combustion of the oil in the small fire boxes of our boilers. Carbon was deposited on the walls of the boiler and heavily on the floor. Part of the trouble might be that we use mechanical atomization only.

In this area of Colorado, No. 6 fuel oil is available to us from only one source, and the quality of the oil is equal to road asphalt. It has heavy deposits of petroleum carbon in it and we had trouble keeping the oil filters clean and the pipes from sludging up. It might be that a cleaner or a better grade of No. 6 would be available in other areas that would work. This item plus the incomplete combustion decided us to fire No. 5 fuel oil.

We are presently using No. 5 fuel oil, with very good success. However, due to the market situation, we are thinking seriously about going to No. 2 diesel fuel oil. The cost difference between the two grades of oil for the quantities we burn is almost negligible and the difference in cost of operation would more than compensate for the difference in fuel cost. With No. 2 fuel oil no heating is required.

I hope this information is what is desired, but if further detailed information is needed, we would be glad to furnish additional information based upon our experience here.

R. A. KENDRICK
Director
Physical Plant Department
The Colorado College

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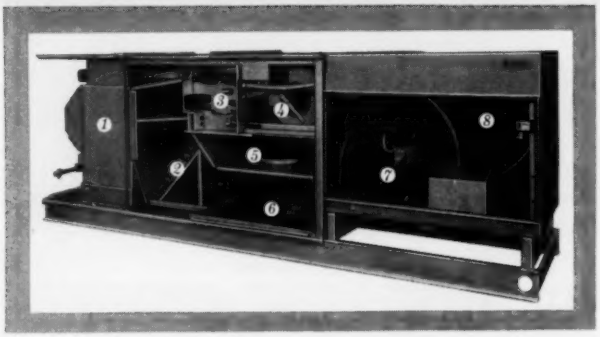

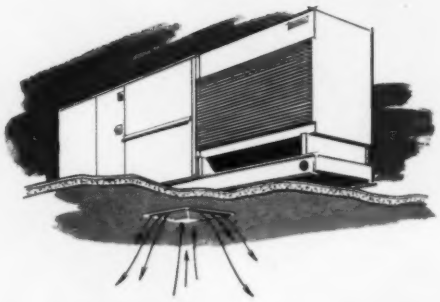

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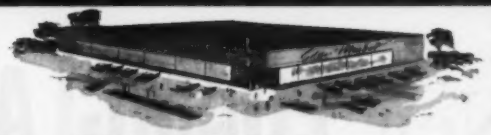


SKYLINER by JANITROL

DOESN'T USE INSIDE SPACE... ELIMINATES DUCT SYSTEM... ALLOWS REDUCTION IN BUILDING HEIGHT... INSTALLS *FAST* WITH LESS LABOR

Whether you should specify the Janitrol Skyliner depends on the job, of course. But if the budget is tight, and you're looking for ways to chop costs without penalizing quality, by all means consider the Skyliner.

Shipped completely factory assembled, tested and ready for installation on the roof, the Skyliner "package" provides *really* economical heating, cooling or year 'round conditioning. Conditioned air is circulated through a ceiling diffuser (located beneath the unit) in the conditioned area. No duct system is needed . . . total building height can be reduced. It has an unobtrusive, low silhouette . . . no stack is required . . . flue gas exhauster is furnished. And not a single cubic foot of usable inside space is used by the Skyliner system!

One or more Skyliner units may be used to provide a simple, efficient zone-controlled comfort system, with each Skyliner controlled by its individual thermostat. A wide range of capacities is offered to match the needs of each zone.

The Skyliner is completely enclosed in a weatherproof, insulated, aluminized steel cabinet. The unit has been operationally tested in 60 m.p.h. winds and for two hours at 12-inch/hr. rainfall. No water or sewage service, no refrigerant piping or charging and no complicated electrical wiring are required. All important factors in cutting costs and speeding up installation!

Here are Some Points to Remember about the Janitrol Skyliner

Multiple Unit Zone Control Type—You can have an individually sized and controlled unit for each occupancy area. Each unit operates only for its own zone, without standby or transmission losses. Multiple units assure continuity of service, since the shut down of a single unit for service or maintenance will not affect performance of other units.

Low Installed System Cost—A Skyliner packaged system offers substantial savings over a conventional site-fabricated central system by:

- Elimination of equipment room.
- Elimination of duct system.
- Elimination of wiring, assembly, installation and checking of individual system components.
- Elimination of water or sewage service.

Meets or exceeds national standards—All Skyliner units carry the certification seal for capacity and performance according to the rigid standards of the Air-Conditioning and Refrigeration Institute. Components are listed by Underwriters' Laboratory and the American Gas Association.

Leasing Plan to Save Capital Investment A complete Skyliner system can be leased on a long-term basis. Permits owners to keep their working capital working.

HEATING & AIR CONDITIONING

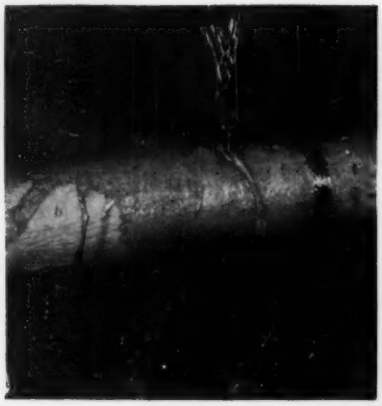
A DIVISION OF MIDLAND-ROSS CORPORATION, COLUMBUS 16, OHIO

IN CANADA: MOFFATS LTD., TORONTO 15

A DIVISION OF M-R MIDLAND-ROSS CORP.

New **FOAMGLAS®** STAY-DRY

Five important benefits for all



Constant insulating value. North Brothers Contractors, Atlanta, Ga., found an excellent way to prevent insulation "fade" on building service piping at Colbert County Hospital, Sheffield, Ala. The low-cost solution was FOAMGLAS STAY-DRY Pipe Insulation. The closed glass cell composition of FOAMGLAS makes it completely impervious to water and atmospheric moisture—even in this highly humid climate. Thus, it never loses its insulation value, assures constant thermal efficiency for the life of the building.

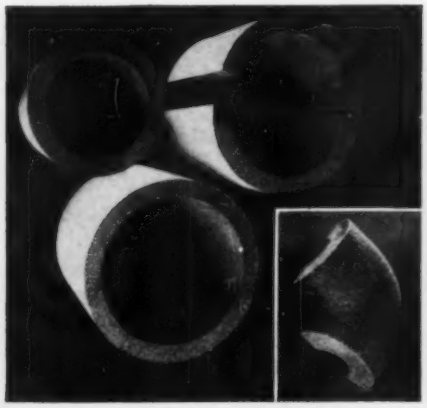
Installed and finished in one operation. There is no priming of the pipes at the beginning of the job. Just apply the 24-inch sections of FOAMGLAS, seal the longitudinal flap of the jacket with PC's Pittseal 222 and apply a 3" butt strip. Band at the butt joints and center of the segment. No separate vapor barrier or vapor seals are necessary since FOAMGLAS is its own vapor barrier. Sections are easy to cut and shape to accommodate any pipe run irregularities. One easy operation with one material from one supplier.

No weak spots . . . no slump or sag. Its high compressive strength lets FOAMGLAS support its own weight. There is no slumping or sagging of the insulation, regardless of how high the vertical piping runs may be. That same strength permits pipe hangers to support the insulation without danger of compression or puncture. This prevents thermal short circuits and eliminates the expense of wrapping hangers in felt. Since FOAMGLAS eliminates condensation, hangers will never rust out.

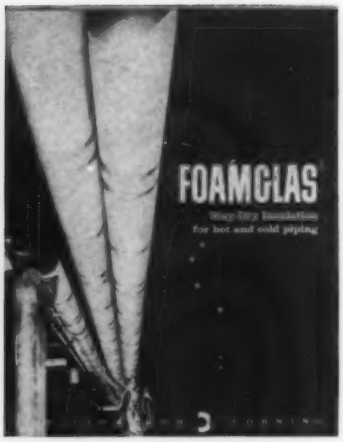
P I T T S B U R G H

Pipe Insulation...
building service lines

No fire hazard. FOAMGLAS is inorganic so it cannot burn—even when subjected to the extreme test illustrated here. To insure this complete incombustibility, even the Kraft-laminate jacket is *self-extinguishing*, and no additional fire-proofing treatments are necessary. Many insulations act as a wick in cases of fire, but FOAMGLAS is the only completely fireproof insulation available to commercial builders today—and at no additional cost.



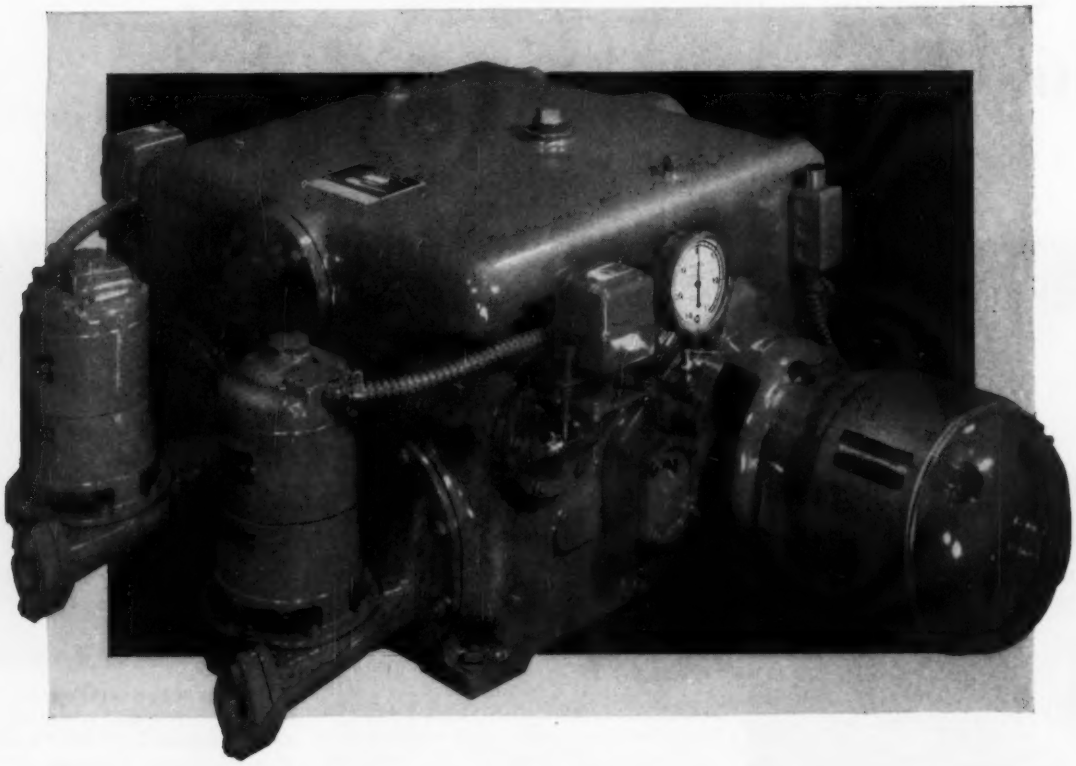
Complete range of sizes and fittings. Now complete piping systems can have all the benefits of FOAMGLAS STAY-DRY Pipe Insulation, for temperatures ranging from +35° to +350°F. Available in 1″ and 1½″ thicknesses for all lines from ½″ copper tubing to 12″ I.P.S. Sizes through 6″ I.P.S. are shipped in 24″ lengths; 8″, 10″, and 12″ I.P.S. in 18″ lengths. Fitting covers and elbows can be furnished for all fittings used in piping systems up to 12″ I.P.S. This full range of sizes makes FOAMGLAS suitable for ice water lines, chilled water lines, low pressure steam lines, hot water and dual temperature lines as well as larger underground piping. Standard FOAMGLAS is ideal for tanks and allied equipment in building service systems.



Write for new catalog. For detailed information, write for our new FOAMGLAS STAY-DRY Pipe Insulation Catalog, FI-108. Just address your request to: Pittsburgh Corning Corporation, Department HP-31 One Gateway Center, Pittsburgh 22, Pa. In Canada: 3333 Cavendish Blvd., Montreal, Que.

PC CORNING

THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS



It's the Nash CSM

No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- **Increased air capacity induces rapid system response without wasteful overheating.**
- **Separate air and water pumps individually selected to meet actual job requirements.**
- **Control system that operates individual pumps only when needed.**
- **Flexibility permitting addition of radiation without changing basic pump installation.**
- **Low, low, return line connection.**

NASH ENGINEERING COMPANY
438 WILSON, SO. NORWALK, CONN.

• A laboratory in New York State now tests cables for extra-high voltage power transmission. Equipment capable of producing 3 million volts and testing 150 ft lengths of cable carrying up to 350 thousand volts for periods as long as three years is isolated in a precisely controlled atmosphere which must be kept to a relative humidity of 40 percent or less — no matter what the weather outside may be. Here is a discussion of the design features of the heating and air conditioning systems that provide the optimum in assured test conditions.

Air Conditioning Prevents Interruption Of Extra-High Voltage Cable Testing

By LEWIS SMITH
Heating Engineer

HERE is a case of specialized air conditioning design brought to a unique plane. Because of the nature of the job, there is no counterpart to it anywhere in the world.

The new extra-high voltage laboratory of the Anaconda Wire and Cable Co. at Hastings-on-Hudson, N.Y. cost 1¾ million dollars. It was constructed because of an ever-growing demand for the transmission of large blocks of electric power to distribution points in large cities.

It has become increasingly difficult to locate overhead transmission lines for this kind of high-voltage transmission. Now, even the spaces beneath city streets are getting so crowded that no more room can be found for underground cables — even when each cable will carry what was until lately considered the limit of 138,000 volts.

Lab Gives High Voltage Capability

Hence there is need to investigate the possibility of going to voltages never before considered possible or feasible, at least in this country. Until this laboratory was built, there was no suitable means for testing full-sized commercial cables for such high voltage. The cables must be tested not only for insulation breakdown, but more especially under simulated operating conditions of cycling loads, such as power companies experience.

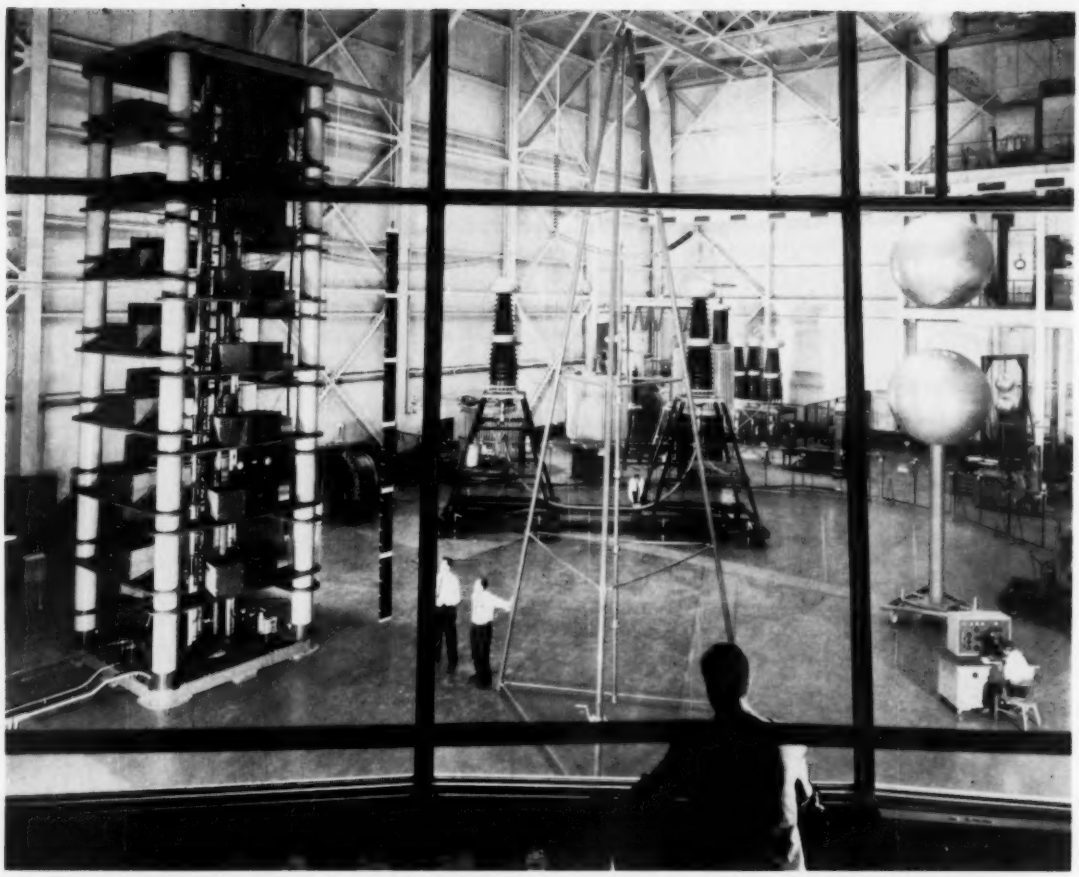
Widely varying loads produce changes in cable temperatures which cause great strains and internal changes in the cable. These effects can only be diagnosed through long continuous runs — sometimes for as long as two or three years.

Within the new lab, means are provided for testing 150 ft lengths of cable with terminals and splices at 350,000 v (50 percent more than the presently contemplated operating voltage of 230,000) while handling a current equivalent to the desired load.

Humidity Is A Prime Factor

Humidity control in the lab is of vital importance for several reasons. Extra high voltage cables are insulated with an oil impregnated paper which is hygroscopic to the extent that if exposed to humid air for several hours (as when terminals and splices are made up) enough moisture may be absorbed to form a potential electric breakdown cause at some later date.

This is why, when splices are made in manholes beneath city streets, some means are provided to dry the air. Hence, design conditions for the lab are based on a maximum relative humidity of 40 percent.



INSIDE LABORATORY as seen from glassed-in observation balcony appears relatively empty due to restrictions on proximity of high voltage equipment. Air conditioning equipment platform and supply ducts can be seen in background

Furthermore, without proper air conditioning, testing might have to be suspended on very humid days, thus breaking the necessary continuous operation pattern mentioned earlier. Now tests can be conducted without regard to atmospheric conditions in the Hudson River valley.

Finally, air conditioning eliminates the possibility of leakage currents being transmitted over moist surfaces, does away with the danger to personnel and instruments, and even makes it possible to explore the effect of varying humidity on the insulation.

Layout Fits Specialized Needs

The building itself is 155 ft long, 89 ft wide, and 66 ft high. Inside, the floor area seems to be largely open space. This is due to the "striking distance" requirement. A safe distance between equipment items must be maintained to avoid the danger of a sparkover. For the "impulse generator," which can develop 3 million volts, the safe distance is no less than 24 ft.

Short pieces of cable are hung between two pot heads for momentary breakdown or impulse tests. For continuous run testing, 150 ft lengths with terminals and splices are hung in a tunnel which runs the length of the building.

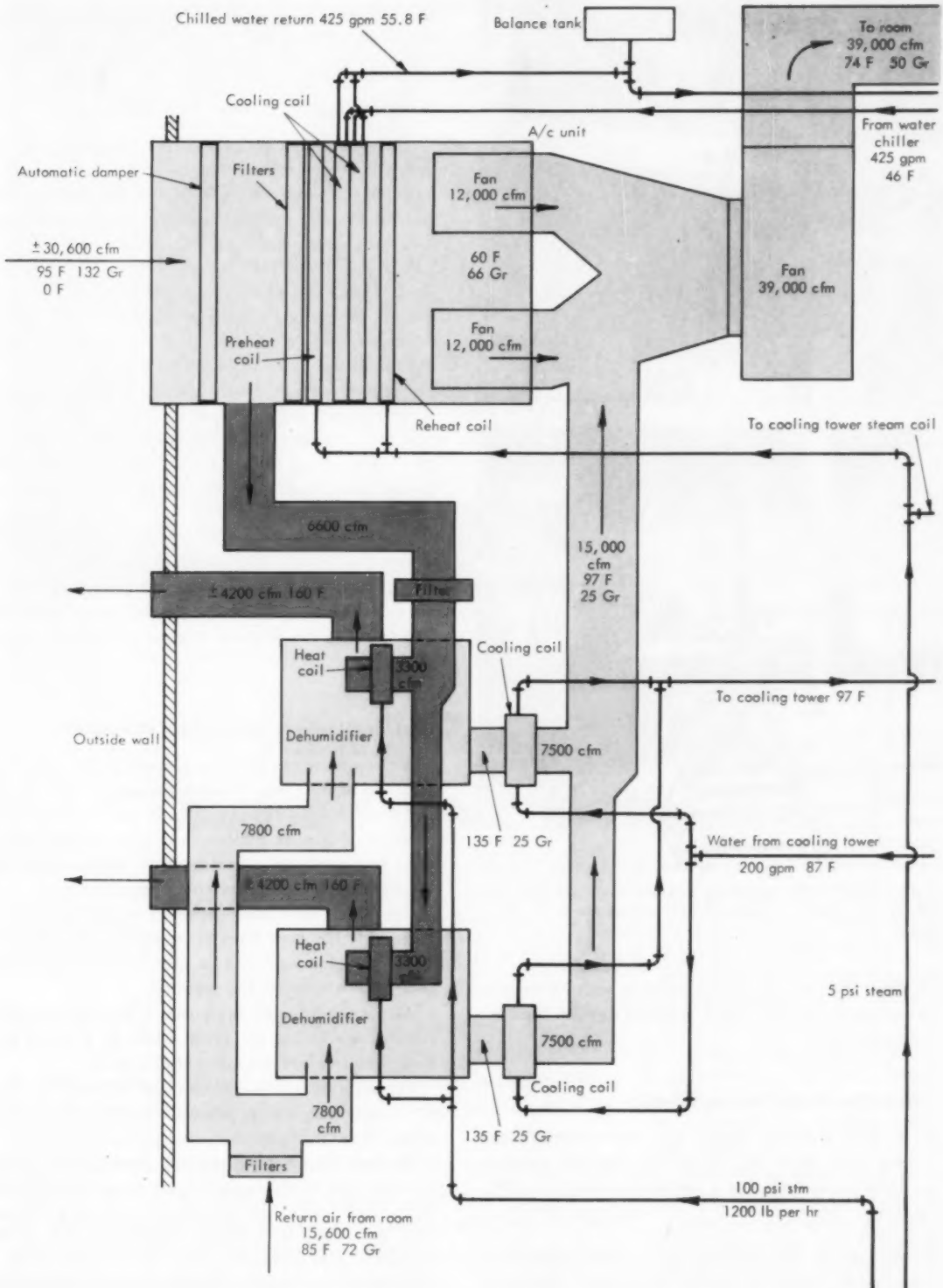
The lower 9 ft of the exterior walls are of brick, backed by concrete blocks and stucco. The remainder consists of fluted aluminum prefabricated panels backed by 1½ in. glass fiber insulation. The insulation is faced with 18 gage galvanized steel sheets. The wall has a U factor of 0.125 Btu per hr per sq ft per F.

20 gage steel roof decking is covered with a vapor barrier, then with 2 in. fiber board insulation, and then with 5 ply asbestos-felt roofing paper, for a calculated U factor of 0.15.

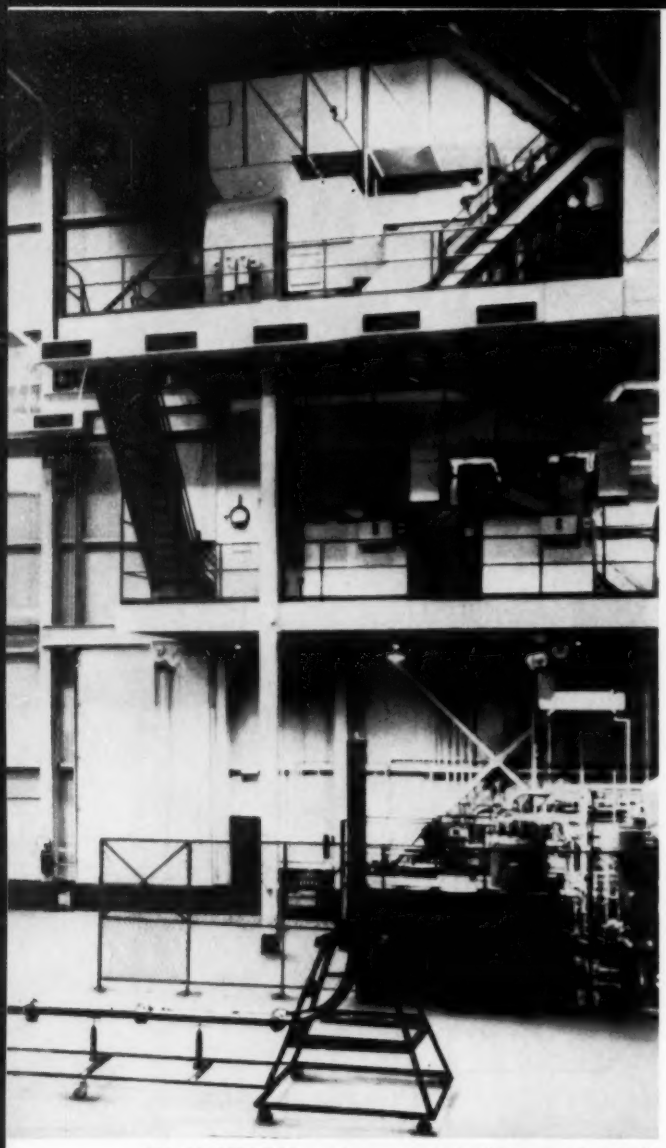
Radiant Grids Supply Heating

A 9 in. concrete floor slab was poured over a continuous copper sheet vapor barrier which rests on a crushed rock base. Prefabricated grids of ½ in. flexible copper tubing were then laid on top of the concrete and adjusted to fit the space available.

The tubing grid now carries 85 F water to supply heating at the rate of 435,000 Btu per hr. This serves



SUPPLY AIR and air drying systems are shown in light and dark gray, respectively. Outdoor and return air are mixed in fan chamber of single large built-up air conditioner, in which heating and cooling coils are supplied from remote chiller and boiler. Return air is passed through pair of silica-gel dryers, thence over cooling coils connected to condensing water line from cooling tower. Dark gray shows how outdoor air in conjunction with steam heating coils is used for silica gel regeneration



AIR HANDLING equipment and air dryers are installed above floor level as shown. Supply outlets are 30 ft above floor

to offset the heat loss of the building with an outside temperature of zero. Inside temperature can then be as high as 65 F.

Shield for High Voltage Effects

A silver soldered copper wire mesh overlays the tubing grid. Mesh and tubing were bonded together to form a solid grid over the whole floor area. The grid was then embedded in a 3 in. layer of tinted concrete.

This copper and steel interior serves as a protective electro-static shield, to prevent interference with local radio and television reception and with the New York Central railroad signal system which is close by. The building has no windows, and the corona effect of extremely high voltage can be observed even during the daytime. All inside doors have been fitted with gaskets, and a glass observation balcony is located in one corner of the space.

Built-Up System Cools, Dehumidifies

A 174 ton capacity centrifugal compressor is installed in the plant boiler room. Load estimates were based on the maintenance of an 85 F DB temperature and 40 percent relative humidity inside when outdoor temperatures are 95 F DB and 78 F WB.

A single large built-up air conditioner receives about 24,000 cfm of outside air through a filter, and conveys it through a 5 psi steam preheat coil, then through a cooling coil (using chilled water at 46 F) and finally through a steam reheat coil.

The two heating coils are sized so as to heat outside air from zero to 75 F in winter.

Return air at the rate of 15,000 cfm is passed through a pair of silica-gel dryers and is mixed with the outdoor conditioned air at the fan inlet before delivery to the room.

Return condensing water from the cooling tower is piped to cooling coils in the dehumidifiers to cool the discharge air to 97 F. Outside air is also channeled to heating coils in the dryers, where steam at 100 psi furnishes heat for regeneration of the silica gel beds.

Dry Air Blankets Equipment, Personnel

Air supply to the laboratory space is via outlets at each end of the room. These are mounted 30 ft above the floor. Air distribution is such that a blanket of conditioned air 30 ft deep, which covers all equipment and personnel, is maintained. Higher space in the building is used mainly for a travelling crane.

Convectors have been installed along the outside walls near the floor level to counteract any possible cold drafts, but have seldom been needed during the two years that the lab has operated.

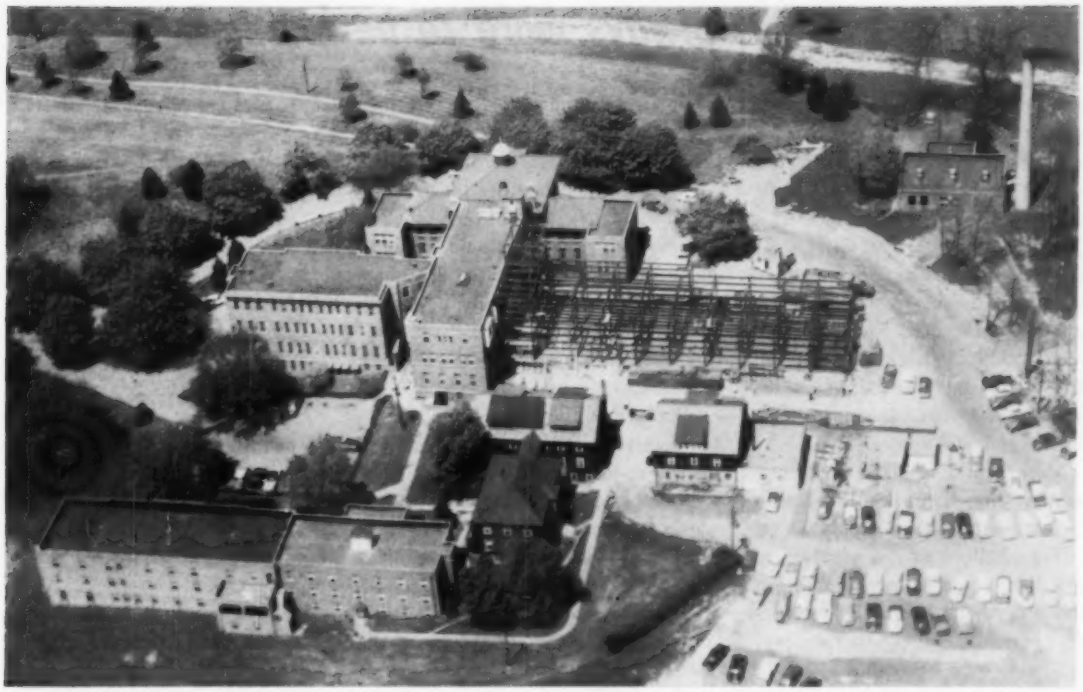
All air conditioning equipment is located on a platform at one end of the room, about 20 ft above the floor. Return air is also taken at that point.

Temperature control of the air delivered by the air conditioning unit is accomplished by conventional means.

Because the relative humidity maintained within the structure is of unusual importance, a humidistat is installed within the laboratory space and acts to start the dryers as a relative humidity value of 40 percent is approached.

A continuous recorder provides a permanent record of the relative humidity in the space.

The air conditioning contractor for the laboratory was the Mance Corp., of New York. The building was designed by the owner's construction engineering department. ≠



VIEW OF HOSPITAL COMPLEX at Indiana, Pa., shows original medical building with new wing (now completed) at upper center, three nurses homes in foreground. Steam plant at top right supplies heating to all buildings via 8 in. underground line. Steam line from boilers to hospital proper is 400 ft long

Vacuum Return Cures Hospital's Steam Heating Ills

By EDWARD HOFFMAN
Chief Engineer
Indiana Hospital

• With a gravity type return and no vacuum, a campus-type hospital steam heating plant was noisy and inefficient. Condensate remained in radiators and return lines, forcing a quick drain on the steam supply when automatic zone valves opened. The installation of an impulse type vacuum receiver for the condensate return system has kept radiating surfaces dry during off-heating periods, quieted noisy pipes, and drastically reduced the steam requirements.

NATURE puts up a tremendous resistance when we try to change the state of things or alter her mode of travel. Compare the speed of heat transmission by conduction to that of radiation.

Again, it takes almost a thousand times as much heat to change a drop of water to steam (liquid to gas) as to raise its temperature one degree.

This article tells how a steam heating system was improved by removal of the burden of vaporization within the radiating equipment.

A Case In Point

The hospital complex at Indiana, Pa., consists of a 200-bed medical

building plus three nurses' homes, all served by a remote steam plant and together having a total of 33,106 sq ft EDR, or almost 8 million Btu per hr.

The hospital proper is 400 ft from the steam plant. The two are connected by means of an underground 8 in. main steam supply line. A branch from the hospital, 150 ft in length and 4 in. in diameter, supplies steam to the smaller nurses' homes.

Each building is zoned separately, and each is equipped with an automatic steam supply valve.

Four boilers, two of which were installed in 1930, are located in the boiler house. Two of these supply normal steam demands, and two are kept in reserve.

Noise and Inefficiency

Normal practice in the past was to maintain a boiler steam pressure of 10 psi. Steam condensate was returned by gravity, and without vacuum.

The hospital had long been plagued with sleep disturbing intermittent noises in the condensate return piping. This was due to gases entrapped within distant radiators, and to condensate and sediment remaining in the returns.

Besides, whenever three or more of the zone steam supply valves opened within a short time of one another, boiler steam pressure dropped to ounces. Firemen had to be constantly on the alert with firing irons and extra coal to regain steam pressure, and later to add feed water to avoid excessive pressure. Thus, low water had to be maintained for quick steam production, and to allow for later feed increase.

The Cure

To cure the long-standing problem, an impulse type vacuum receiver was installed for the return system. A vacuum of 7 in. Hg is now maintained in the lines.

Before the modification, the closing of, say, three of eight zone steam supply valves would begin the difficulty, since the steam within these zones when it condensed would reduce in volume and pressure, creating a partial vacuum.

Because of the vacuum, no condensate could leave the zone, and as traps cooled and opened, condensate, vapors, and gases from down stream would be drawn backwards through the traps and into these zones.

Drops of condensate on the inner surfaces of the radiators would flash to vapor as the pressure dropped. These would then recondense, as cooling continued, until the inner surfaces were coated with a blanket of condensate.

Steam Pressure Drops

When the automatic supply valves again opened, the entering steam had to first increase the temperature of this condensate blanket to steam temperature. Because of the great amount of heat required to vaporize the condensate, the steam supply was soon exhausted, and steam pressure dropped.

The beginning of this cycle produced initial condensation in the steam supply. The same phenomenon occurs in reciprocating steam engines.

Radiators Are Dry

With the modification, the problem has been cured. Now when these same three supply valves close, steam in the radiators continues to condense. Traps cool and open. Now, however, the 7 in. vacuum within the return lines serves to withdraw condensate, vapors, and gases from the effected zones.

Pressure drops quickly, and the temperature of the condensate on the inner radiation surfaces is raised, in effect, above the flash point. As it vaporizes, it too is withdrawn and all inner surfaces are left hot and dry.

Reduce Boiler Drain

When the supply valves open, incoming steam meets no condensate, but only dry heating surfaces. Steam can condense only as the metal slowly warms. Steam traps warm and close.

There is no initial condensation, and the demand for steam appears only as a reducing pressure wave on the boiler, easily met by the flashing to steam of the latent heat in the boiler water.

Since the modification, the normal boiler pressure has been reduced to 3 psi. Eight zone supply valves opening concurrently do not disturb the pressure level.

Firing is steady and fuel consumption has been reduced. Clinker build-up is less, and ash handling easier.

Gain Quiet, Efficiency

Of course the bothersome noises in the return piping have been eliminated. But perhaps the greatest benefit has been directly to the fireman, since firing is steady and there is no concern over quick loss of steam pressure, over-firing, and hasty addition of makeup feed.

We should always look for new and better ways of operating, even in areas that have become pretty much "standard practice." What we take as good practice today may not be so acceptable tomorrow. It seems there is always more to be learned about efficient steam heating. ⫩

In Hartford, Connecticut, an urban redevelopment project will be provided with public utility-owned steam and chilled water via 14,000 ft of underground pipeline. Does this portend a widespread entrance into the heating-cooling field by utilities? What are the problems involved? Is there an economic "rule of thumb" that can be applied? Here's what the designer of the Hartford system and the utility president think.

Will Public Utilities Sell District Heating and Cooling?

WHEN individually owned and operated heating and air conditioning units are replaced by a central plant, as in large building operations, the separate users of the service become customers instead of owner-operators.

It is no revelation that this results in economies, convenience, and efficiency which are advantages to both tenants and suppliers.

As year 'round air conditioning has developed, the idea of centralized service for heating and cooling has been expanded beyond the limits of a single building operation — as witness the various campus-type schools, central airport plants, and others now in operation.

The Next Step

The next "logical step" — that of supplying heating and air conditioning to a large number of dissimilar buildings and users, much as fuels and power are furnished now — has been a subject of considerable speculation.

Part of it is already familiar in the form of district steam operations. Now the second half of the idea is becoming a reality in Hartford, Connecticut. There the urban redevelopment project called Constitution Plaza will be furnished with both steam and chilled water from one large central plant. The services will be metered and charges made by a utility, the Hartford Gas Co.

The project will include three major office buildings, a large hotel, a new broadcasting facility and a shopping center. Two older buildings will also be included on the lines.

Plant Is Big, Expandable

To briefly describe the service plant, the initial installation will include three steam turbine driven centrifugal refrigeration machines with a total capacity of 6000 tons, plus a 500 ton steam absorption chiller. Condensing water will be furnished from the nearby Connecticut River. Chilled water supply and return lines will be 24 in. in diameter. A 12 in. supply and 5 in. return line will handle steam requirements. Boilers for the system are capable of supplying 150,000 lb of steam per hr.

All supply and return lines are underground, and each building is separately metered. Each of the supply and return piping loops will be 3600 ft long, for a total length of 14,400 ft.

It will cost about $3 million to install the system, and provision is made for further expansion to other buildings as the plan develops.

Ancestory Is Well Known

Erik B. J. Roos, partner in the firm of Seelye, Stevenson, Value and Knecht, who designed the system, emphasizes that the physical fact of such a plant is not a new idea. Other campus-type systems of similar capacity have proved both efficient and economical. The novelty, he says, lies in the fact that for the first time the total environmental services will be

sold and maintained by a public utility.

There is no simple rule, according to Mr. Roos, to indicate whether a similar plan would be feasible for other locations. A list of some 50 redevelopment projects in 25 cities which might be studied with a view toward such a proposal has been prepared by Carrier Corp. However, Mr. Roos insists that a complete study for each project is necessary to indicate whether the plan would work. He notes that in general, the larger a central plant the greater are its advantages, but since services have to be distributed through pipelines, the longer the lines the greater are the disadvantages.

What Are the Advantages?

It is quite obvious, says Mr. Roos, that a central plant would eliminate duplication in certain kinds of equipment, such as boilers, water chillers, fuel storage, cooling towers, smoke stacks, and so forth. In addition, operating personnel would be drastically reduced, and consequently the larger single plant could command more highly trained and more expensive operators.

The points in favor of the central plant as summarized by Mr. Roos include the lower cost per unit of output with larger machines, and a proportionate decrease in the amount of space required. Also, construction for the equipment site is cheaper, since expensive hotel or similar building space is not used.

Sometimes the central plant can be located on a less desirable piece of real estate, within the limits imposed by distribution costs. Larger machines are liable to more technical refinement than are smaller units, and there is less duplication of auxiliaries. The need for spare equipment is reduced, and fuel and power may be obtained on large quantity discounts. The larger, more flexible plant can better handle the normal condition of partial loads than can a number of smaller units serving separate buildings.

On the Negative Side

Again paraphrasing Mr. Roos, the chief disadvantage to a central plant revolves around the need for external distribution lines. These must be installed underground and protected against corrosion, electrolytic action, and traffic vibration. The soil composition may make it difficult to lay the lines, and beneath city streets, costs will go up as more sewer lines, electric conduits, etc. are encountered. Longer lines will be porportionately more expensive to install, and suffer more from the effects of heat losses and gains.

Finally a proper study of any proposed location would serve to place some of the more intangible results in perspective. Individual building managements might welcome the opportunity to be relieved of the administrative chores of separate heating and cooling. Building capital investment might be less, and community contributions in the form of better smoke and noise control increased.

Cost, Load Are Prime Factors

Mr. Roos concludes that the two main considerations are the cost of production and the actual existence of the required load. The latter he sets at a minimum feasible point of 2500 tons of cooilng and a steam demand for 50,000 lb of steam per hr, subject to local conditions. The investment needed for this kind of capacity cannot lie idle, he says, and therefore the load must be assured before installation.

Urban redevelopment projects, he feels, offer perhaps the most fertile area for consideration, since they are completely planned as integrated projects beforehand. Once the initial installation is completed, expansion for new customers is economically feasible within the limits of distribution costs.

The further considerations advanced by Mr. Roos, which can only be applied for specific cases, include investment finance charges, depreciation factors, tax structures, insurance, maintenance, and others. He sees a bright future for the public utilities in this sort of venture.

The Utility View

From the standpoint of the public utility, the question is largely one of solving an old problem.

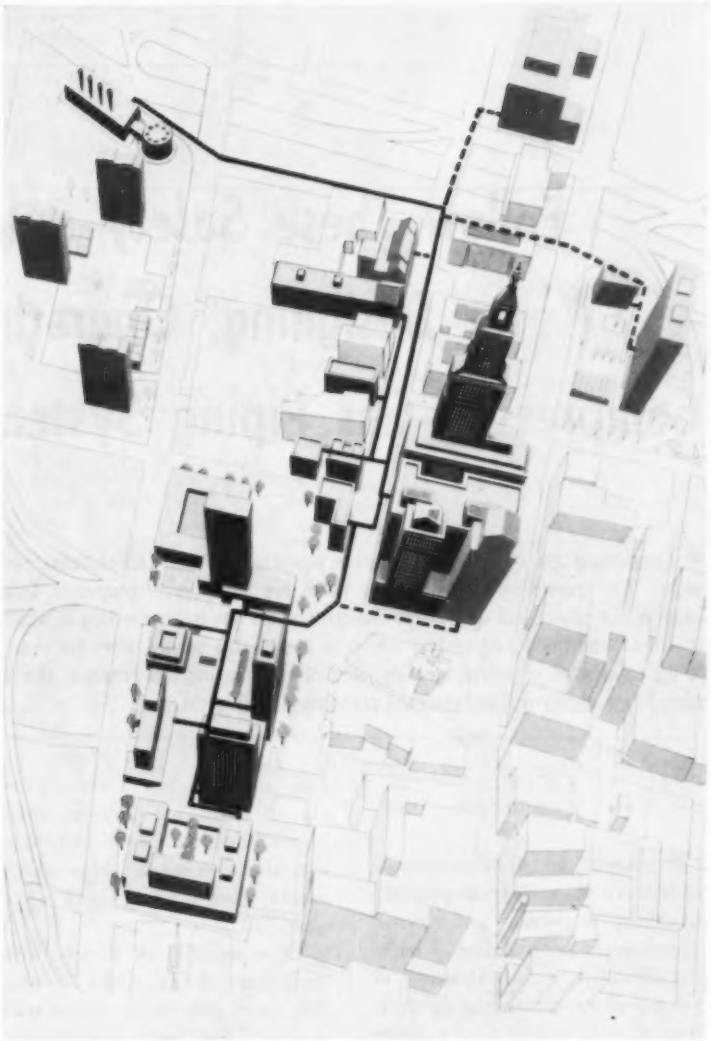
William T. Jebb, president of The Hartford Gas Co., cites three reasons why his firm decided to undertake the Hartford project. One reason was an opportunity to join in the community's joint effort to grow and prosper as a modern, convenient city.

Another was the common desire to provide for healthy expansion in the utility business itself, with new avenues of service and brightened prospects for the future.

The third reason — and the one which dealt with the old problem — was that by entering the heating-cooling business the utility could hope to ease the perennial difficulty of balancing the gas load for summer and winter operations.

The Peaks and Valleys Problem

Mr. Jebb notes that gas companies are required to accept, generally, the same approximate quantities



SERVICE LINES for supplying steam and chilled water to various Hartford, Conn., buildings are planned as shown here. Central heating-cooling plant is at upper left. Constitution Plaza, now being constructed will consist of dark shaded buildings at lower left. Dark structures in center are existing buildings which will be connected to lines when service begins. Dotted lines indicate extensions, to new and existing structures, now being contemplated

of natural gas, from suppliers, each day throughout the year. Demands, however, are far greater during winter, or heating months, than during the warmer weather.

Entrance into the business of supplying cooling services, therefore, may enable the utility to create a more nearly level curve on gas supply, since in the summer the fuel will be used to fire the boilers, producing steam for the cooling operation.

A known and expanding cooling load, he says, may enable the utility to even out the "summer valley," and by improving the overall load factor, to improve its purchasing position with the natural gas suppliers.

Sees Rapid Expansion Ahead

While the present design capacities of the Hartford plant are enough to insure a profitable operation, Mr. Jebb anticipates a rapid increase in demand and a consequent expansion of his firm's facilities. By 1964, he says, steam capacity may be 225,000 lb of steam per hr, with a cooling capacity close to 10,000 tons. By 1965, the plant could account for a 1 to 1½ million dollar annual gross revenue if demands increase as expected.

Service Will Benefit All

Mr. Jebb feels certain that the Hartford project will enable the utility to provide a service to customers which would be difficult for them to obtain alone, and for this reason looks forward to increasing growth for the gas company during the coming years.

These remarks by Mr. Jebb and Mr. Roos were presented at a recent luncheon in New York, sponsored by Carrier Corp. ≠

Follow These Safety Rules for Designing, Operating Compressed Gas Piping Systems

• Compressed gas cylinders are common equipment in many laboratories and plants, but present some use hazards which are not always recognized. Such hazards are related not only to the character of the gas but to the way in which it is used and the piping system set up to provide the service. Here are short, to-the-point rules of safety covering installation, use, and maintenance, plus a compilation of physical and chemical properties for 51 gases.

By ELLIS L. STOUT
Los Alamos Scientific Laboratory

COMPRESSED GAS cylinders are safe containers when they are properly handled, inspected, and tested. There seems to be a kind of built-in difficulty in identification of gas cylinder contents, and the question of color coding always comes up for discussion.

Various schemes for color coding are used by gas manufacturers and suppliers, but there is little uniformity as to the color used for each gas. Such color codes should be considered as only for identification by the manufacturer, and each user should provide his own marking.

At Los Alamos, we label each cylinder with the name of the gas it contains, since we feel that no color code, no matter how standard or nearly universal, is as good as the name of the gas.

Match Local Conditions

Identification is probably the basic safety factor in using compressed gases, but once the character of the gas is established, there are other, common rules which should always be followed while using it.

These have to do largely with the nature of the piping installation which permits operations with multi-cylinder banks for efficient, dependable work.

The Compressed Gas Association and other organizations publish lists of safety rules to be followed, but often these need some modification or extension to suit specific conditions.

Manifolds and Pig-Tails

A gas manifold serves as a common outlet when two or more cylinders of gas are to be used. Except in unusual cases, it is probably better to purchase standard manifolds. Home-made units can give many problems.

The connecting line between cylinder and manifold is generally known as a "pig-tail" because of its shape. Pig-tails made of copper have a tendency to work harden with the repeated bending that occurs when cylinders are replaced. Since the lines are normally exposed to cylinder pressure (up to 2500 psi), work hardening is undesirable. Work hardened lines are more susceptible to fracture while under pressure, or in bending to accomodate fittings.

Unless facilities are available to flame anneal pig-tails, they should be replaced when it becomes apparent that they are hardening.

Isolate Cylinders

Manifolds should be designed with valves at each pig-tail so that cylinders may be replaced without interrupting the gas service. Each manifold ought to be equipped with a gas regulator and a main manifold valve. Service piping beyond the regulator should be fitted with a pressure relief valve, set at the maximum working pressure for the system. Relief valves for toxic and flammable gases must be vented to safe areas.

Piping is generally steel, wrought iron, or copper. When tubing is used, it is generally of seamless copper, brass, or stainless steel, but unalloyed copper cannot be used for acetylene systems, and some very corrosive gases such as hy-

TABLE 1 — CHEMICAL AND PHYSICAL properties of 51 gases commonly used in laboratory and in other operations. The table is continued below and on succeeding pages

	Acetylene	Air	Ammonia	Argon	Boron Trichloride	Boron Trifluoride	Butane	Iso-Butane	Butene, 1	Butidiene	Iso-Butylene
Chemical Symbol	C_2H_2		NH_3	A	BCl_3	BF_3	C_4H_{10}	$(CH_3)_3CH$	C_4H_8	C_4H_6	C_4H_8
Boiling Point, C	Sublimes	−191.5	−33.4	−185.9	12.5	−99.9	−0.5	−11.72	−6.3	−4.6	20.0 F
Melting Point, C	−81.8 F	−213 to −225	−77.74	−189.26	−107	−128	−158.29	−159.42	−130.0	−108.7	
Critical Temp., C	97.4 F	−104.7	132.4	−122.46		−12.25	152.01	137.44	160	163.1	
Critical Pressure (psi)	906	532.00	1623.9	690.65		708.4	535.96	520.24			
Specific gravity of gas (air = 1)	0.90	1.000	0.58	1.3799	1.4338	2.394	2.0889	2.0688	1.937	1.877 at 60 F	1.94
Specific gravity* of liquid (water = 1)		0.995	0.6812	1.402		1.59	0.6008	0.59591	0.595	0.6205 at 70 F	0.626
Cu ft/lb at 70 F	14.5	13.34	22.37	9.681	3.5	5.57	6.451	6.468	6.4	7.16	
Physical state in Cylinder/70 F	Dissolved	Gas	Liq.	Gas	Liq.	Gas	Liq.	Liq.	Liq.	Liq.	Liq.
Toxic	No	No	Yes	No	Yes	Yes	No	No	No	No	No
Normally Corrosive	No	No	Yes	No	Yes	Yes	No	No	No	No	No
Flammable (in air)	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes
Explosive Range in percent	2.5 to 81.0		16-25	No	No	No	1.9 to 8.5	1.8 to 8.4	1.6 to 9.3	2.0 to 11.5	1.8 to 8.8
Cylinder or valve safety device	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
I. C. C. classification	F. G.		N.F.G.	N.F.G.	C.L.	N.F.G.	F.G.	F.G.	F.G.	F.G.	F.G.
Cylinder pressure (psig)	250 at 70 F		114	2640	7	1800	22	31	13	24	23
Water soluble	Yes		Yes	No	Yes	Yes	slight	slight	No	No	No
Flash point, F	Gas			No	No	No	−76	Gas	−112	Gas	Gas
Ignition Temp., F	635		1204	No	No	No	806	1010	723	842	869

	Carbon Dioxide	Carbon Monoxide	Chlorine	Chlorodifluoromethane	Cyclopropane	Deuterium	Dimethylamine	Dimethyl Ether	Ethane
Chemical Symbol	CO_2	CO	Cl_2	$CHClF_2$	$(CH_2)_3$	D_2	$(CH_3)NH$	CH_3OCH_3	C_2H_6
Boiling Point, C	Sublimes −56	−192	−34.05	−40.8	−32.9	−417.26 F	7.4	−24.5	−89.1
Melting Point, C	−78	−207	−100.98	−160	−126.6		−96	−138	−183.26
Critical Temp., C	31.34	−139	144.0	96	124.65	−390.82 F		127.0	32.27
Critical Pressure (psi)	1056.93	525	1103.67	726	782	239		756.8	693.65
Specific gravity of gas (air = 1)	1.529	0.9678	2.4903	1.41	1.4810		1.55	1.617	1.0488
Specific gravity* of liquid (water = 1)	1.156		1.557		0.638 at 0 C		0.68 at 0 C	0.724	0.5459
Cu ft/lb at 70 F	8.7291	13	5.359	4.4	9.262		8	8.346	12.72
Physical state in Cylinder/70 F	Liq.	Gas	Liq.	Liq.	Liq.	Gas	Liq.	Liq.	Liq.
Toxic	No	Yes	Yes	No	No	No	Yes	Yes	No
Normally Corrosive	No	No	Yes	No	No	No	Yes	No	No
Flammable (in air)	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Explosive Range in percent	No	12.5 to 74	No	No	2.40 to 10.4	5.0 to 75	2.8 to 14.4	3.4 to 18.0	3.0 to 12.5
Cylinder or valve safety device	Yes	Yes	Yes	Yes	Yes		No	Yes	Yes
I. C. C. classification	N.F.G.	F.G.	C.L.	N.F.G.	F.G.	F.G.	F.G.	F.G.	F.G.
Cylinder pressure (psig)	825	1000	82	123	75		10	60	528
Water soluble	Yes	Yes	Yes	Slight	No	Slight	Yes	Yes	No
Flash point, F	No	Gas	No	No	Gas		less than 0		Gas
Ignition Temp., F	No	1204	No	No	928			662	950

drogen fluoride require monel or nickel piping.

Special Cases

Oxygen systems operating at 700 psi and above should be constructed of non-ferrous tubing, pipe, and fittings. These oxygen systems must be absolutely clean and free of dirt, dust, oil and grease.

All flammable gas systems should be electrically grounded. If flexible hose is to be used on a manifold system, it should be selected for a safety factor of four. When flexible hose exceeds 18 in. in length, (and if it is not shielded from personnel), both ends should be firmly anchored to prevent whipping should either end work loose under

	Ethylamine	Ethyl Chloride	Ethylene	Fluorine	Helium	Hydrogen	Hydrogen Bromide	Hydrogen Chloride	Hydrogen Fluoride	Hydrogen Sulfide
Chemical Symbol	$C_2H_5NH_2$	C_2H_5Cl	C_2H_4	F_2	He	H_2	HBr	HCl	HF	H_2S
Boiling Point, C	16.6	12.2	−103.7	−306.2 F	−268.9	−252.8	−67.0	−85	19.4	−60.36
Melting Point, C	−80.6	−138.7	−169.15	−223	−272.1	−257.14	−86.0	−111	−83.0	−85.52
Critical Temp., C	183.2	187.0	9.51	−247F	−267.95	−239.95	90.0	51.4	230.2	100.40
Critical Pressure (psi)	1104	749.0	729.65	808	18.37	173.41	1267.5	1224		1291.78
Specific gravity of gas (air = 1)	1.56	2.2200	0.9744		0.1380	0.0695	2.71		0.69	1.1879
Specific gravity* of liquid (water = 1)	0.778	0.906	0.5674	1.11 at 187 C	0.1253	0.07081	2.16 at −68 C		0.988 at 13.6 C	0.9539 at 63 C
Cu ft/lb at 70 F	7.9	6.00	13.69		96.71	192	4.4	11.0	17.0	11.23
Physical state in Cylinder/70 F	Liq.	Liq.	Gas	Liq.	Gas	Gas	Liq.	Liq.	Liq.	Liq.
Toxic	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes
Normally Corrosive	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes
Flammable (in air)	Yes	Yes	Yes	Yes	No	Yes	No	No	No	Yes
Explosive Range in percent	3.5 to 14.0	3.8 to 15.4	3.1 to 32		No	4.0 to 75.0	No	No	No	4.3 to 45.0
Cylinder or valve safety device	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
I. C. C. classification		F.L.	F.G.	C.L.	N.F.G.	F.G.	N.F.G.	N.F.G.	C.L.	F.G.
Cylinder pressure (psig)	2.1	5.6	1250		2000	2000	320	613	0.9	252
Water soluble	Yes	No	Yes	Yes	No	Slight	Yes	Yes	Yes	Yes
Flash point, F	70.0	−58	Gas		No	Gas	No	No	No	Gas
Ignition Temp., F	723	966	842		No	1085	No	No	No	500

	Krypton	Methane	Methyl Bromide	Methyl Chloride	Neon	Nickel Carbonyl	Nitric Oxide	Nitrogen (water pumped)	Nitrogen Dioxide	Nitrous Oxide
Chemical Symbol	Kr	CH_4	CH_3Br	CH_3Cl	Ne	$Ni(CO)_4$	NO	N_2	NO_2	N_2O
Boiling Point, C	−244 F	−161.4	4.5	−23.7	−410.7 F	43	−151	−195.808	21.3	−88.465
Melting Point, C	−157	−182.6	−93	−97.6	−248.67	−25	−161	−210.02	−9.3	−90.9
Critical Temp., C	−81.40 F	−82.1		143.0	−379.66 F	200	−94	−147.15	158.2	36.5
Critical Pressure (psi)	720	687		952.0	395	450	945	477.47		1039
Specific gravity of gas (air = 1)		0.55	3.27	1.74		1.3185	1.27	0.96699		1.529
Specific gravity* of liquid (water = 1)			1.732	0.919 at 70 F				0.808		1.229 at 90.5C
Cu ft/lb at 70 F		24	4.05	7.66			10.8	13,80		8.711
Physical state in Cylinder/70 F	Gas	Gas	Liq.	Liq.	Gas	Liq.	Gas	Gas	Liq.	Liq.
Toxic	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No
Normally Corrosive	No	No	No	Yes	No	No	Yes	No	Yes	No
Flammable (in air)	No	Yes	Yes	Yes	No	Yes	No	No	No	No
Explosive Range in percent	No	5.0 to 15.0	13.5 to 14.5	10.7 to 17.4	No		No	No	No	No
Cylinder or valve safety device		Yes	Yes	Yes		No	No	Yes	No	Yes
I. C. C. classification		F.G.	poison B	F.G.		F.L.	poison A	N.F.G.	poison A	N.F.G.
Cylinder pressure (psig)		2000	13	59		0	480	2000	5	800
Water soluble	No	No	Slight	Slight	No	Slight	Slight	Slight	Yes	No
Flash point, F	No	Gas	Gas	Gas	No			No		No
Ignition Temp., F	No	999	999	1170	No			No		No

operating pressure.

Pressures in piping systems between the manifold and the gas-using equipment ought not to exceed the working pressure of the equipment, and to make sure, the system should be fitted with a pressure relief valve.

Except in permanent production type facilities, there should be strict limitations placed on room to room or between-level piping of flammable, toxic, or corrosive gases.

Regulators, of course, reduce cylinder pressures to working pressures, and maintain a preset flow or pressure rate. For most applications, we prefer a two-stage regulator. The practice of using the same regulator for different gases is not recommended. Serious accidents have occurred when regulators which had earlier been used for fuel gases were placed in oxygen service.

Proper regulators will be equipped with self-resetting relief valves or frangible discs whose function is to protect the low pres-

	Oxygen	Ozone	Phosgene	Propane	Propylene	Sulfur Dioxide	Sulfur Hexafluoride	Trimethyamine	Vinyl Bromide	Vinyl Chloride	Xenon
Chemical Symbol	O_2	O_3	$COCl_2$	C_3H_8	C_3H_6	SO_2	SF_6	$N(CH_3)_3$	C_2H_3Br	C_2H_3Cl	Xe
Boiling Point, C	−182.96	−169.4 F	8.2	−42.12	−47.75	−10.08	sublimes	3.5	15.8	−13.9	−163 F
Melting Point, C	−218.4	−249.6	−104	−187.71	−185.25	−75.52	−50.8	−124	137.8	−159.7	−112
Critical Temp., C	−118.84	53.8 F	182	98.89	95	157.50	45.6	161			61.88 F
Critical Pressure (psi)	715.84	802	996	621.35	660.29	1128.50	540	615			855
Specific gravity of gas (air = 1)	1.10495	1.7	1.392 at 19C	1.553	1.481	2.2629		2.03		2.15	
Specific gravity* of liquid (water = 1)	1.140	1.5 to 1.7	3.4 at 20 C	0.5823	0.6095	1.4601		0.63		0.97	
Cu ft/lb at 70 F	12.08	8.02	5.0	8.547	9.009	5.897	2.5	6.1		5.7	
Physical state in Cylinder/70 F	Gas	Gas	Gas	Liq.	Liq.	Liq.	Gas	Liq.	Liq.	Liq.	Gas
Toxic	No	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	No
Normally Corrosive	No	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	No
Flammable (in air)	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	No
Explosive Range in percent	No	No	No	2.2 to 9.5	2.4 to 10.3	No	No	2.0 to 11.6		4.0 to 22.0	No
Cylinder or valve safety device	Yes		No	Yes	Yes	Yes	Yes	No	Yes	Yes	
I. C. C. classification	N.F.G.		poison A	F.G.	F.G.	N.F.G.	N.F.G.	F.G.	F.G.	F.G.	N.F.G.
Cylinder pressure (psig)	2000		30	109	125	35	320	20	6	30	
Water soluble	Slight	Slight	Yes	No	Yes	Yes	No	Yes	Slight	Slight	No
Flash point, F	No	none	No	Gas	Gas	No		Gas		Gas	
Ignition Temp., F	No		No	871	927	No					

*Symbols used: C.L. — corrosive liquid; F.G. — flammable gas; F.L. — flammable liquid; Liq. — liquid; N.F.G. — non-flammable gas; *— at boiling point unless otherwise specified; I.C.C. Poison Ratings: A = Extremely dangerous, B = Less dangerous, C = irritating substances, D = radioactive materials.*

sure chamber and outlet gage.

Acetylene delivery should be at pressures less than 15 psi, since withdrawal of acetylene at pressures above that value may permit the acetone in the cylinder to be carried into the gas stream.

Approved regulators for compressed gas service should have vented housings to provide for release of pressure in a bourdon tube failure.

Regulations under which we operate require that each compressed gas cylinder must be equipped with one or more safety relief devices approved as to type, location, and number by the Bureau of Explosives, and these must be capable of preventing explosion of the normally charged cylinder when it is placed in a fire. Specifically excepted from this requirement are

1) Cylinders 12 in. or less in length, exclusive of neck, and with a 4-½ in. or less outside diameter, unless these cylinders are charged to 1800 psi or more.

2) Cylinders charged with nonliquified gas under 300 psi.

3) Cylinders charged with poisonous gas or liquid.

4) Cylinders charged with fluorine.

Most cylinder valves are equipped with standard overpressure devices of either the springload relief valve, fusible metal plug, or frangible disc types, or with a combination of frangible disc and fusible plug.

Handling and Storage

Though compressed gas cylinders are rugged containers, they should still be handled with care. In movement or in storage, valves should be tied, strapped, chained, or otherwise fixed in a manner to prevent tripping. Acetylene cylinders must always be stored upright.

It is a gross mistake to attempt to force a valve. If it can't be opened by the attached wheel or small wrench provided, safety demands that it be properly tagged and returned to supplier or storage.

Cylinder valves should be opened slowly. High pressure gas has considerable thrust if the valve is opened wide very suddenly, and while an accident of this type is not very likely, it has been known to happen.

Table 1 lists the chemical and physical properties of 51 gases commonly used in laboratory and other operations.

References

1) Compressed Gas Systems, Los Alamos Scientific Laboratory Safety Group

2) American Standard Code for Pressure Piping, ASA B13.1-1955

3) Flammable Liquids and Gases, Vol. 1, National Fire Protection Association (1958)

4) Compressed Gases and Gas Regulators, compiled by the Matheson Co.

5) Laboratory Gases and Equipment, Ohio Chemical and Surgical Equipment Co.

6) National Fire Protection Association Standard No. 51 ‡

This article has been adapted from a paper presented by Mr. Stout at the recent National Safety Congress in Chicago.

A recent conference in Chicago occasioned some informed discussion on problems of coordinating improved lighting and air conditioning techniques for the modern office structures of today. Here is a digest of the talks presented by a lighting specialist, a consulting engineer, an illumination engineer, an architect, and a building owner, representing

Five Views of Integrated Lighting-Air Conditioning

A CONFERENCE to discuss the aspects of integrated lighting and air conditioning systems as they are seen by the various disciplines involved was held recently under joint sponsorship of the Illinois Chapter of ASHRAE, the Chicago Chapter of AIA, and the Chicago Lighting Institute.

The meeting, held at the Chicago Lighting Institute, attracted 130 engineers and architects.

Chairman for the meeting was C. E. Heimbrodt, specification department, Holabird and Root, architects. Speakers were as follows:

W. S. Fisher, office lighting specialist, General Electric Co.

Samuel R. Lewis, consulting engineer and a member of HPAC's board of consulting and contributing editors.

R. G. Slauer, manager of engineering, fixtures, Sylvania Electric Products, Inc.

W. A. Netsch, Jr., partner, Skidmore, Owings and Merrill, architects.

R. King, assistant vice president, Harris Trust and Savings Bank, Chicago.

The remarks of the various speakers are paraphrased below.

The Lighting Specialist

W. S. Fisher reviewed design factors in the total environment, with particular reference to office spaces.

"Since office help is usually written off as overhead, environment is important because of its effect on productivity. The great increase in usable office space and its importance in new construction markets can be related to the ratio of office workers to those in plants.

"In 1900 this ratio was one office worker to 30 industrial workers. By 1935 the ratio was 1 in 10, and in 1958 there was one office worker for every 2.2 people in industrial plants.

"Automation (and greater productivity) in industrial plants, as opposed to little automation of office work, is responsible in part for this changing ratio. But the fact that it *is* changing indicates the force behind the current growth and development of office space.

"The total owning and operating costs for office space average about $46 per sq ft per year, for all types and ages of buildings. This includes "people" costs as well as space expenses. The breakdown of this amount is of interest because it indicates the relatively small part that is spent on providing better environment. It also indicates how small an increase in productivity is needed to justify the improved environments that are currently recommended.

INTEGRATED lighting-air conditioning system at Harris Trust and Savings Bank, Chicago

"The total cost is comprised of the following parts (all are per sq ft per yr):

People (salaries & wages)	$38.00
Furniture and machines	1.50
Services and supplies	2.25
Space (Nat'l Bldg. Manager's Assn.)	4.25
	$46.00

"Since these figures are averages for old and new structures alike, an additional cost of 50 cents to $1 per sq ft should probably be added, since very little air conditioning is included in relation to the number of buildings.

"Lighting at 35 fc represents 25 cents of the space cost ($4.25) and at today's lighting standards of 100 fc it would cost about 75 cents per sq ft per year."

The remainder of Mr. Fisher's talk was devoted to an integrated heating and lighting system at G.E.'s Nela Park. The results of this study and an engineering analysis were included in the article "*Building Design Trend Paves the Way For Integrated Lighting, Cooling*," by Mr. Fisher and J. E. Flynn in the October 1960 issue of Heating, Piping & Air Conditioning.

The Consulting Engineer

Samuel R. Lewis discussed air conditioning and air handling, with reference to installations in which he had utilized the advantages of integrated lighting and air conditioning systems.

After a review of the transient effects of solar radiation on lighting and cooling systems, he told how his office had designed the air conditioning for a number of large war-goods plants.

"These were of the blackout type, without any windows or skylights. Such plants depend entirely on electric illumination.

"The problems of refrigerated cooling and of acceptable air distribution in such buildings are simple, compared with the problems of promoting comfort in many modern over-glassed gold fish type rooms. In such rooms, we meet the irritating and fluctuating necessity to combat the heat and the eye glare of the sun.

"I was called on recently to correct the unsatisfactory heating of a printing plant that had been mistakenly provided with thousands of sq ft of glass skylight.

"The leakage of heat through this single layer of glass was tremendous, even though the glass was so covered with dust and mud and soot as to be opaque to any useful solar light.

"I asked, 'Why not be good housekeepers and clean your skylights?' The answer was 'We can't obtain enough employees to clean the skylights, and even if we could hire the help, the cost would be more than the electric light costs — which we have to use anyway since the solar illumination fails due to clouds.'

Integrated Lighting-Air Conditioning

"I refused to recommend adding more heating capacity to burn more fuel to lose more heat through those windows and skylights. Instead I recommended that these glass areas be replaced with a properly insulated barrier.

"We have designed new electric lighting with fluorescent troffers in the ceilings of a block-square general office building to replace old incandescent fixtures that make more heat than light. We arranged the air supply and exhaust ducts for complete year 'round air conditioning with air diffusers between the light troffers.

"We remove, in this case, the heat from computing machines and from the high tension office workers at the rate of more than 50 Btu per hr per sq ft of floor. Every 6 sq ft of floor in such rooms needs removal of as much heat as would be given off by a 100 watt incandescent electric lamp.

"Before the new lighting in this banking room, which approaches 85 fc in intensity, and the new ventilation arrangements were installed, the interior temperature, despite open windows and thickly dispersed desk fans, often reached 100 F when the outdoor temperature was 70 F.

"The owner of the building, as well as we, appreciates the coordinated design of the ventilation, lighting, and comfort cooling.

"One prominent tenant in the building, who occupied two block-long upper stories, was provided with new fluorescent lighting and new acoustic-faced suspended ceilings. The light troffers are on 8 ft centers.

Natural Ventilation Fails

"The tenant hoped that the hundreds of windows around the four exposures and around a large interior court would give adequate cross ventilation. Our advice to install mechanical ventilation with air supply and exhaust ducts was ignored.

"The first summer, following the rehabilitation of the electric wiring and lighting and acoustic ceiling, found the tenant requesting 90 window type air conditioners, each of 3/4 ton capacity.

"The original lighting circuits could not serve so great an addition to the electric load, and new separate circuits for the cooling machines then were installed at considerable cost. Power costs, to say nothing of the lubrication, cleaning, and weather protection, for so many separate machines and their air filters is tremendous, compared with the cost of similar service for the four central station air conditioning plants that have *now* replaced the window units.

"We once designed supply ducts and diffusing openings for delivery of cool air, that served acceptably as long as the original inadequate lighting fixtures were retained.

"Then, in this case, without telling us about it, the owner replaced the old lights with new suspended and shielded fluorescent fixtures, that were located for illumination efficiency, but that disregarded entirely the previously built-in air ducts and diffusers.

"The cool air streams that originally spread over the occupied area with little interference now splashed against the sides of the light fixtures, and were deflected downward. Complaints of drafts from bald heads and bare shoulders followed.

"This occurrence is a common one where ceilings are low, and where air movement and lighting fixtures are not coordinated. Electric light fixture manufacturers are constantly striving for improvement — especially by helping us to combine air diffusion with light diffusion. We are glad to join in this movement.

Combination Units May Be Used

"A fluorescent troffer in the ceiling may have auxiliary, (and decidedly unobtrusive) slots through which properly conditioned air may be introduced. It is not difficult to arrange the air supply and exhaust ducts so as to avoid interference with the ceiling lighting troffers and electrical connections. High air velocities through the fixtures' narrow slots must be avoided, since air jets through the ceiling encourage the deposit of room dust around the slots.

"There is no longer any tendency to leave the lighting fixtures exposed; instead glass or its equivalent is installed below the bright lamps to diffuse light and create the impression of a level ceiling.

"Careful material selection for the troffer-bottom plate must never be neglected, since the plate must be easily and safely removable for maintenance, and since the radiant electric heat from the tubes and ballast must be constantly dissipated by the circulating air.

"New metals and new finishes for lighting reflectors are available. Glass facings must not rattle. Air currents from poorly designed air supply diffusers and the reflected glare from fixtures have been responsible for typists' and draftsmen's habits of constantly relocating their desks.

"Almost daily we are designing refrigerated air conditioning systems for stores, restaurants, and offices. With each design, we must provide for removal of excess heat. In one very large building, the heat from electric lights in interior sales rooms increases

the temperature at breathing level to 80 F. Air must be introduced at a temperature considerably cooler than 60 F, and at the rate of as much as 2 cfm per sq ft of floor.

"This experience explains the interest on the part of ventilating engineers in a lamp which, like the firefly, will be able to give off cold illumination.

"We appreciate every opportunity to design electric lighting in coordination with refrigerated air conditioning. We have grown up, so far, through a background, as in art museums and banking rooms, of removing the surplus heat delivered by illumination."

The Illumination Engineer

In discussing the relation between lighting levels and comfort, Mr. Slauer stated and answered three questions:

"Is the trend toward increased footcandles essential? This is a controversial subject, presently best answered by the work of Dr. Blackwell, of Ohio State University. The doctor's work is predicated on visual performance, and he has shown that performance will increase with increased lighting levels. As present Dr. Blackwell concludes that this rise in performance would continue even beyond the point reached with presently contemplated lighting levels.

"The Blackwell ratings are all in terms of visual performance, and thus underestimate the subjective factors in lighting, such as visual comfort. These must also be considered in design.

"Can we design for high fc with visual comfort? Higher intensities tend toward increasing discomfort, because brightness, glare, and reflections increase with greater intensity.

"Larger light sources, however, can help to reduce brightness, and through proper design the other difficulties can be controlled also. This is accomplished by improving brightness contrast, selection of wall reflectances, etc.

"What does the lighting engineer mean by coordination? The illumination engineer looks upon the ceiling as traditionally his work site.

"One may look at a building as though it were comprised of two parallel planes. The floor is purchased by the client, to place thereon his furniture, equipment, and other things necessary to his business. The ceiling must carry many utilities, including lighting and air conditioning. Other ceiling functions — acoustic treatment, location of sprinkler heads, partition anchors, etc., are important but subordinate.

"Thus, coordination of the two planes becomes necessary. Acoustical treatment, while sometimes included in the integrated ceiling, can also be accomplished by utilizing the floor and free standing devices. This is not possible with lighting and air conditioning. Therefore, I suggest that the acoustical engineer might devote his energies to using the floor and walls.

"The choice of coordinated lighting and air conditioning systems will depend on the lighting quality sought. For 50 to 150 fc, the troffer is probably the best answer."

The Architect

Mr. Netsch gave warning that the architect may again wish to have a piece of the ceiling.

"The architect today is taking a closer look at the ceiling, and it may become once more a part of the space in design considerations.

"A building can no longer be considered as a collection of individual products, as it was 15 years ago. It and all its components must be a part of the total environment provided for the occupants.

"From the architect's viewpoint, we are not certain that constant light intensities are necessarily desirable. Different intensities within the same space may be more desirable. Overhead fixtures (and presumably this applies to air distribution outlets also) must be further sublimated. They should not be 'objects' but rather parts of the whole ceiling, and to this end consideration should be given to providing shallower lighting units. Current fixture depths are probably based upon beam sizes for the modules now being used. New materials and new ceiling treatments will call for shallower units."

The User

Speaking from the user's standpoint, Mr. King placed considerable emphasis on the need to consider maintenance in design, which, he suggested, usually came up a poor third in most plans. While his remarks were directed primarily to the lighting phase of the integrated system, they apply to the mechanical systems as well.

"Careful education of the owner on maintenance requirements is a must. This is necessary because it is difficult to obtain competent maintenance help, and tenants rightfully demand top notch service.

"One might lament the passing of standing steam radiation, which served as a nice psychological out during malfunction of the heating system. A few raps with a hammer on the radiator by the mechanic would solve many complaints, even though a system might be inoperative for several days.

"With our new system, complaints are more difficult to answer." ≠

Combination Centrifugal / Absorption Cooling May Save Dollars

Engineer describes typical combination steam turbine centrifugal chiller and steam absorption unit air conditioning system for large tonnage requirements — compares possible operating costs of this system with those for electrically driven cooling.

By VICTOR CHUN
Mechanical Engineer
Daniel, Mann, Johnson & Mendenhall
Planning-Architecture-Engineering

IN CHOOSING an air conditioning system of large tonnage, it is common practice to settle upon either a steam absorption system or an electric or steam driven centrifugal chiller. However, by using a combination of absorption machine and steam turbine drive centrifugal chillers, it may be possible to obtain a more efficient system.

Briefly, a typical combination system operates as indicated in Fig. 1. High pressure steam from a boiler or other source is used to drive the turbine for the centrifugal chiller, after which it exhausts at low pressure into two absorption machines, which will act as steam condensers.

The centrifugal chiller capacity would be balanced with the steam absorption machine capacities in the design of the system so that all steam would be condensed by the two absorption machines.

Therefore, no water cooled steam condenser would be needed. An economizer is generally used to utilize the heat in the condensate from the absorption machines, and also to lower the temperature and pressure of the condensate for easy return to the boiler (Fig. 2). A steam bypass with pressure reducing valve is provided for the absorption machines so that they can be run independently of the turbine if required.

Split Load Evenly

The capacity of each of the three machines will usually be about 1/3 of the total load. Therefore, should the centrifugal chiller be shut down for some reason, the remaining units could still handle 2/3 of the total load.

However, if it becomes necessary to secure one of the absorption machines, the centrifugal chiller would automatically reduce its capacity by 50 percent. One absorption machine and the centrifugal chiller would then provide 50 percent of the total capacity.

Parallel Water Lines

Chilled water is usually run in parallel through the two absorption machines and then through the centrifugal chiller for most efficient operation, as shown in Fig. 1. Condenser water is run in parallel through the absorption units and the centrifugal machine.

Capacity of the combination system is controlled by a main thermostat in the chilled water line from the centrifugal unit, serving to throttle the steam to the turbine.

Thermostats on the absorption machines are set at system design values for chilled water temperature (usually about 45 F) so that each will call for a full load.

As the system load drops (and the leaving chilled water temperature drops) the main thermostat will throttle the steam supply to the turbine. Since the absorption machine thermostats will not be satisfied, more steam will be demanded than the turbine can exhaust, which will result in a lowered steam pressure into the absorption machines. This will serve to reduce the capacity of these units to balance the reduced steam supply available.

List Design Conditions

The operating conditions of a typical 1800 ton capacity combination system, using 100 psi steam, are as follows:

Total load, 1800 tons

Return chilled water temperature, 57 F

Supply chilled water temperature, 45 F

Chilled water quantity, 3600 gpm

Entering condenser water temperature, 83 F

Leaving condenser water temperature, 99 F

Condenser water rate, 5660 gpm

Steam rate, 12.7 lb per hr per ton

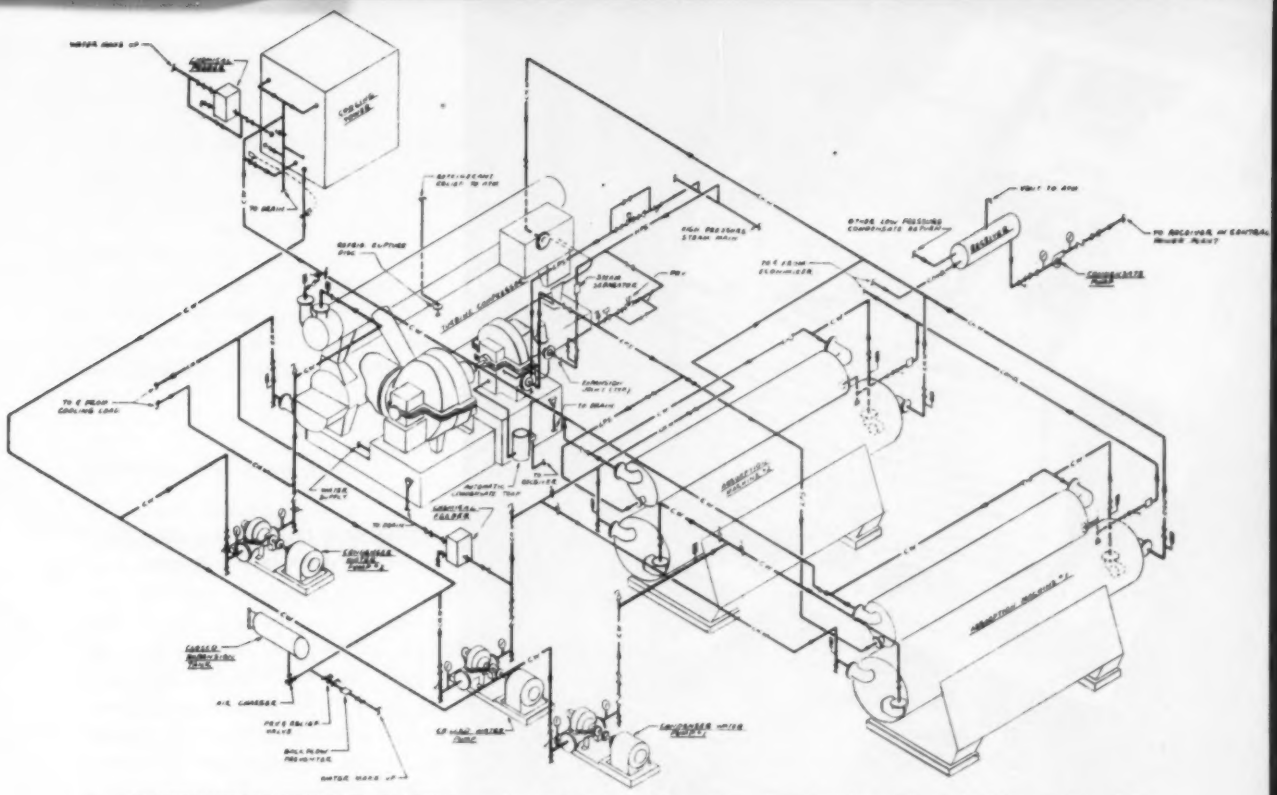
Total steam, 22,800 lb per hr

Compare Costs

The operating costs of a combination system are competitive with either the electrically driven centrifugal chiller system or the absorption machine system. Since steam and power rates vary throughout the country, a detailed operating cost study should be made for each location. However, here is one comparison for a typical 1250 ton capacity system.

A 1250 ton combination system requires 16,400 lb of steam per hr, or 13.1 lb per hr per ton.

The enthalpy of steam (at 100



1 COMBINATION CHILLER SYSTEM may be designed as shown here. Steam exhausts from turbine used to drive centrifugal chiller into two absorption machines which act as condensers. Steam bypass is provided so absorption units can be run independently of the turbine if required

psi) is 1200 Btu per lb, so that the total heat requirement is for 19,700,000 Btu per hr.

The calorific value of No. 2 fuel oil is 140,000 Btu per gal, for a base of 141 gal per hr.

If the boiler efficiency is 70 percent, 141/0.7 gives a requirement of 200 gal of oil per hr.

An assumed fuel cost of 10 cents per gal gives a result of $20 per hr operating cost.

Power costs for an electrically driven centrifugal chiller of 1250 tons could be figured as follows:

1300 hp are required. If the demand charge is $1 per hp per month, the cost would be 1300 × 12 × 1 or $15,600 per yr.

1300 hp × 0.75 = 975 Kwh.

At a cost of 2 cents per Kwh and assuming a 1000 hr year, an added cost of $9750 must be included, for a total cost of $25,350 per yr.

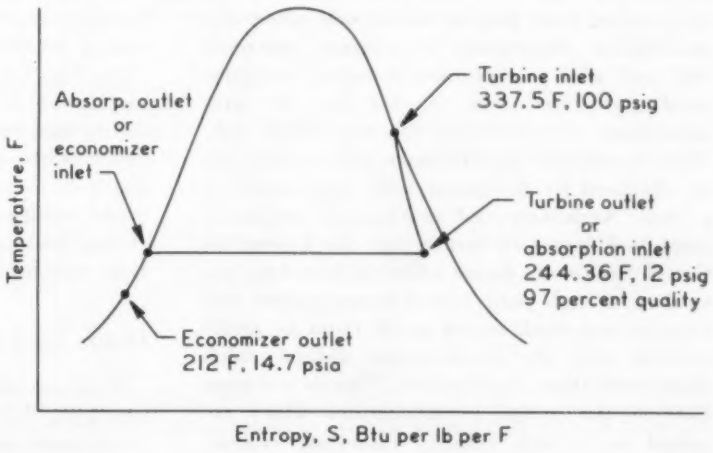
This is 26 cents per Kwh, or $25.40 per hr operating cost.

Using these figures, the cost of steam is less than that of electricity by $5.40 per hr. In one season of 1000 hrs, the saving with the combination system would be $5400.

Since high pressure steam is used, a licensed engineer might be needed to operate the system, and his salary above that of an unlicensed operator would have to be added to the operating cost of the combination system.

The steam needed to operate two 650 ton absorption machines, in order to provide for the whole load, would be approximately 20 lb per hr per ton, which is higher than the 13.1 lb per hr per ton rate needed for the combination system.

The author acknowledges the cooperation of Carrier Corp. in the preparation of this article. ‡



2 ENTROPY DIAGRAM for system with economizer to utilize heat from condensate leaving absorption machines

THE NEW Union Oil Co. main office complex in Los Angeles

by LESTER RIES
Consulting Engineer

Build Air Conditioning Design On Principal Heat Gain Factor

• Any design for large building year 'round air conditioning must take into account all of the various load factors which will affect the installation. Sometimes it becomes apparent that one such — climate, location, architectural style, or other — will be the preponderant consideration for the whole job. Then economies of efficiency and results can be obtained by designing with that factor as a base. Architects and mechanical engineers combined forces to insure that the Union Oil Co. of California home office in Los Angeles, subject to high year 'round temperatures and extreme sun load, would profit from an architectural and air conditioning design which deals with these factors first. This is a discussion of the design considerations which resulted in a high velocity dual-duct system.

CLIMATIC CONDITIONS in some parts of the United States place an inherent emphasis on certain design considerations in large building air conditioning and heating installations.

For instance, in the warmer areas, the expected heating load is generally relatively small, while the cooling load requires the major power and capacity factor. At the same time, if a building is so situated that both average mean temperature and the year 'round incidence of sunlight are high, the additional cooling load imposed upon a building's perimeter areas must be a major consideration.

Design for Los Angeles Climate

These are obvious facts, but they introduce some interesting challenges to the design, installation, and maintenance engineers.

A case in point is the new Union Oil Co. of California home office in Los Angeles.

The Union Oil Center required 3 yrs and $24 million to construct, in order to provide space for 1200 employees previously located in six buildings scattered throughout Los Angeles.

Apart from the location, architectural, and space requirements imposed by the owners, the best possible working environment for all personnel was sought.

Complex Has Four Units

The site chosen is a square city block of approximately 5 acres on the western perimeter of the downtown area. The entire structural complex consists of four buildings arranged in a "U" pattern. A main office tower of 13 stories is located on a north-south axis and provides about half of the total 400,000 sq ft of floor space. Two four story buildings house various departments of the firm, and the two story Beaudry St. building accommodates a 495 seat auditorium, 500 seat cafeteria, lounges, and a utility service area. Below the complex, parking for 1400 cars is available on four sublevels.

Consider Temperature, Solar Factors

The summer design temperature in Los Angeles is 93 F dry bulb, 71 F wet bulb, and 35 percent relative humidity. Winter design temperature is 36 F.

In this area, a principle climatic factor is the continuing direct rays of the sun throughout the year. Temperatures of 85 F with clear sunny skies are common even during winter months.

Since complete air conditioning for all the actively utilized areas was required, a major design problem was to control the sun's rays and the resultant increase in cooling load before the heat penetrated the structure.

Use Sun Position Data

Detailed studies of sun position during different hours and different calendar periods were made, after which the shape of the tower structure and its relative position on the site were determined. Daily and seasonal sun patterns established the parameters for sun control and led to the development of a truncated diamond shape.

This allowed the main axis to be located on a north-south line. Walls on these two exposures are solid to provide a protected area against the maximum intensity of the noon sun. All windows have east-west orientation and the major sun exposure is restricted to the quarter points only.

Sun Shields Give Added Relief

An additional direct result of the solar load investigation was the installation of vertical anodized aluminum fins at spaced intervals along the exterior walls of the buildings. Horizontal aluminum louvers are also used over the window areas. These serve to intercept the sun rays but afford a clear view to the outside. Such devices serve also to reduce glare, and unshaded glass area has been considerably reduced.

The extent of the effectiveness of this fin and louver combination plus the shape and orientation of the main building can be perceived through the fact that only 10 percent of the direct sun load design values were used for the northwest exposure, 14 percent for the west-northwest, 27 percent for southeast, and 36 percent for the east-southeast.

These percentages were applied to the figures representing the maximum heat gain conditions due to

TABLE 1 — CHARACTERISTICS of each of the 10 high and low velocity supply systems which furnish tempered air to the four-building Union Oil Center complex are shown below. The 10th system consists of a low velocity heating and ventilating unit which serves a large cafeteria kitchen from which no air is returned

System	Area supplied	CFM	SP	BHP	Connected HP
S- 1	Tower building, south half, 7th through 13th floors	50,100	7 in.	77.0	125
S- 4	Tower building, north half, 7th through 13th floors	50,300	7 in.	77.0	125
S- 2	Tower building, north half, lobby through 6th floors	59,200	7¼ in.	92.0	125
S- 3	Tower building, south half, lobby through 6th floors	58,600	7¼ in.	92.0	125
S- 5	Fifth St. building, other than bank	54,500	8½ in.	101.0	125
S- 6	Fifth St. building, bank space	12,300	low velocity 2¼ in.	6.8	7.5
S- 7	Maryland St. building	52,400	8 in.	91.0	125
S- 8	Beaudry St. building, auditorium	9,300	low velocity 2 in.	3.9	5
S- 9	Beaudry St. building, other than auditorium	25,000	low velocity 2 in.	10.3	15
	Total air conditioning	371,700		551.0	777.5
S- 10	Beaudry St. building, kitchen ventilation only	11,000	low velocity ¾ in.	2.2	3

Note: The connected motor hp includes compensation for additional static pressure that will be introduced when future activated carbon filters are introduced to the high velocity systems

SHADING DEVICES, consisting of vertical anodized aluminum fins at spaced intervals plus horizontal aluminum louvers over windows at each level, work efficiently to reduce glare; and more important, decrease in unshaded glass area means drastic reduction in heat gain due to solar effects

the direct sun rays, for glass wall construction, on each of the four exposures. Experience has shown that the fins and louvers help further to materially reduce both the cooling and heating loads by entrapping a layer of still air at the building walls. This tends to reduce the outside skin factor, and thus the convective heat transfer.

Design Gives Outside Access

Adequate vertical shafts for the mechanical and utility requirements of the tower building were designed to take advantage of the truncated diamond floor plan. The whole complex is served by a total of 10 double duct supply systems, six of which are high velocity (4000 fpm) three low velocity, and the last a low velocity system which supplies the cafeteria kitchen and is not returned.

Two dual cores were included within the tower, one for each half of the building located approximately one-half the distance between middle and end. The perimeters of the shafts are parallel to the building outline.

Each shaft accommodates both hot and cold supply ducts and return air risers. The largest cold air supply riser is 54 in. in diameter, while the largest warm air supply measures 48 in. Each of the two double shafts serves a quarter of each floor, and in addition, they serve the purpose of structural shear walls to carry earthquake seismic forces which must be anticipated.

Has 900 Separate Zones

The air conditioning provision for the building is basically a high pressure system with approximately 900 separate zones. Each mixing box for perimeter spaces is controlled by a pneumatic thermostat.

Table 1 lists the characteristics of each of the 10 supply systems within the complex. As noted in the table, the six high velocity systems (four in the Main Tower building, and one each in the four-story Fifth St. and Maryland St. buildings) are supplemented by three "conventional" systems serving the two-story Beaudry St. structure plus a separately leased bank suite in the Fifth St. building. In addition, a heating and ventilating unit, unzoned and without cooling provision, serves the cafeteria kitchen in the Beaudry building.

Describe Typical Operation

The following is a brief explanation of the operating pattern for each of the supply systems.

The supply fan is a double inlet, double width, heavy duty unit located in a plenum which also houses the filters. A 125 hp electric motor drives the fan via V-belt transmission.

Outside air supply and return air from the building are joined ahead of the fan, and the combined air passes through a bank of sinuous replaceable media filters and an electrostatic filter. Outside air make-up is controlled automatically by the temperature of the outside air.

The filtered air is discharged through a combination set of coils two rows of which contain hot water and eight chilled water. A set of static pressure dampers backs each set of coils.

The air is cooled and humidified and discharged into the hot or cold mains as required. Square to round transitions occur immediately downstream of the coils. All extensions from this point are composed of standard gage round steel duct, varying in diameter from 54 to 4 in.

Absorb Sound With Glass Fiber

Sound absorption is accomplished by lining a minimum of 35 ft of round duct and two elbows with 200 lb density treated glass fiber material 2 in. in thickness. In each case, the material was sprung into a section of the largest warm and cold air ducts. The extended metal was released against the glass fiber and tack welded in place. Bolted and flanged construction, with the flange extended inside, protects the edges of the insulation.

Further sound absorption is achieved with each mixing box for each conditioned space. These are standard two-valve single operator types, with discharge either directly or through octopus-type ducts to feed various ceiling diffusers.

Install Novel Return Air Grilles

Cloth curtains operating on extruded metal tracks shield glass surfaces in the occupied spaces around the perimeter of the buildings. These tracks are of special design and include a practically continuous slot for the return air opening to a furred ceiling space. That space is used as the return air plenum.

Employment of this device, with thin slot opening, eliminates the need for baffles to interrupt sound transmission between adjacent spaces.

Air conditioned spaces in the interior of the structures are equipped with ceiling supply diffusers, with conventional ceiling registers and lighting coves to handle air return to the return plenum.

Architecture Aids Garage Exhaust

In the tower, one return air fan serves each of the double supply systems within the double risers. All return systems operate on conventional low pressure. A portion of the return air discharges into the chamber of the supply system, as described earlier. The remainder is discharged into the garage area.

This parking area, which subtends the tower building on four levels and extends to the boundaries of the entire block, is bounded by a double wall. An inner concrete wall lines the parking space, and is backed by a 24 in. air space. Another concrete wall backs the soil. Air baffles and numerous dampered openings on the inner wall near the floor and ceiling of each level provide an inexpensive garage exhaust system. Connections to the four 100 hp exhaust fans are made with short runs of sheet metal ducts, which handle a total of 700,000 cfm.

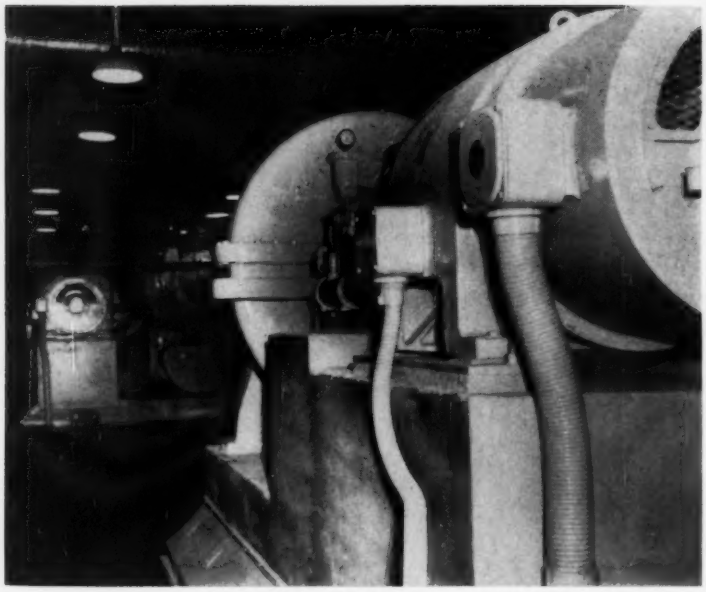
Chilled Water Used in Coils

Chilled water at a temperature of 40 F is circulated through the cooling coils mentioned earlier. Consequently, a relative humidity of 40 percent can be maintained with an indoor temperature of 78 F dry bulb.

Two main open type centrifugal chillers of 725 ton capacity each, plus two 100 ton capacity hermetic refrigeration machines supply the cooling medium. The 100 ton equipment serves the upper floors of the Fifth St. and Maryland St. buildings.

Centrifugal compressors for the larger machines

OUTSIDE AIR intake to buildings is via grilles concealed in perimeter planters



VARIABLE SPEED electric motors, each rated at 700 hp, drive two-stage centrifugal compressors to provide cooling for entire four-building complex. Motors are linked to chillers by speed increaser gear trains

are two-stage, with maximum operating speeds of 3900 rpm. These are linked to 700 hp, 4160 v, variable speed motors with maximum speeds of 1775 rpm by speed increaser gear trains. These main units furnish chilled water for the remainder of the complex, and each is capable of chilling 1800 gpm of water to 40 F. Return water in the closed system is regulated to a temperature of 50 F.

Locate Cooling Tower on Roof

A redwood-fill and basin cooling tower is the only piece of major equipment on the roof of the Tower building. It is enclosed with asbestos-cement sheets. Circulation of condenser water is accomplished by means of a pair of horizontal split-case pumps. The chilled water circuit is free of throttling or mixing controls, thus assuring maximum dehumidification of the supply air.

Three Boilers Supply Heating

The hot water for the heating system is provided through three equal sized low pressure hot water boilers of 10-½ million Btu per hr capacity. An additional low pressure boiler furnishes steam for kitchen use and heat transfer for domestic use. All boilers are fired by natural gas, but light fuel oil is available for use as a stand-by in order to take advantage of the economies of interruptable gas service from the local utility.

Control Experience is Satisfactory

The degree of control obtained through the two-valve, single control mixing and attenuator box installation has been most satisfactory for this system. Only the warm air plenum is controlled by an outside air reset type of control, which acts on a 3-way mixing valve located at each hot water coil.

Outside air intake is restricted to grilles located on the north and south extremes of the main building, and to cleverly concealed grilles installed in horizontal raised planters at various locations near stairways and entrances. The concealment of the low velocity air intake and garage exhaust leaves the entire east and west metal and glass facades completely free of breaks.

In addition to the return fans, and four garage exhaust fans, there are some 28 miscellaneous exhaust blowers scattered in various places throughout the buildings.

Use Step-Down Power

The City of Los Angeles supplies power to the Center at 34,000 v. This is stepped down to 4160 v for the two 700 hp motors which drive the main refrigerating equipment. A final reduction to 110/220 v for general building lighting and services also supplies the remainder of the electric heating, cooling and ventilation equipment.

To note one additional feature of interest — static wires are woven in the carpets throughout the buildings to ground static electricity that is induced because of the dryness of the conditioned air; maintained at 40 percent RH during much of this time.

Pereira & Luckman were the planners, architects and engineers for the project. Frank Konuk is chief mechanical engineer for the firm. ≠

THE EFFECTS of corrosion in a hot water distribution line

By R. H. HAYMAN
Manager, Customer Services
Betz Laboratories, Inc.

Good Procedures Forestall Corrosion In Hot Water Heating Systems

IN RECENT years great interest has been shown in panel heating with hot water as a medium. This type of heating has been successful in both small dwellings and industrial buildings with large floor areas.

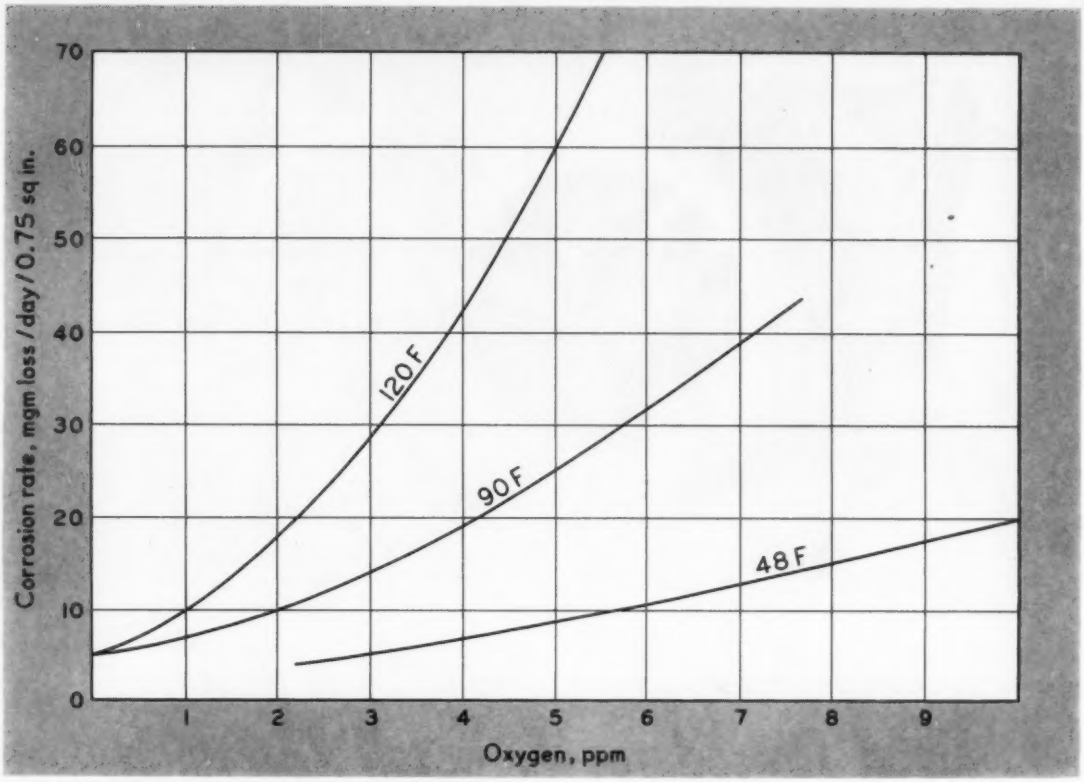
The correct design and normal function of a modern hot water panel heating system provides that the system water will remain in satisfactory chemical balance through control of the sources of contamination, by mechanical or chemical methods, or both. Water is capable of destroying anything man can build, through alternate freezing and thawing, erosion, corrosion or other types of destructive action.

Corrosion, which must be protected against in every steam system, can also occur in a forced water system if the conditions outlined here are permitted. It should not be anticipated that corrosion will be evident immediately upon placing a system in operation. Sometimes the disastrous results of corrosion may not show up for several months or perhaps even years.

Materials Are Usually Not At Fault

When the damage is discovered by the property owner through leaks, inadequate heat due to impeded water flow, valve and pump failure or similar difficulties, the tendency is to blame the materials of construction. The time worn statement that "they simply don't make things the way they used to" almost never applies. Almost always the failures are due to the water conditions that have been imposed on the system through faulty design, improper main-

● This article discusses the mechanism of corrosion which may occur in hot water heating systems, with special emphasis on the effect of dissolved oxygen and on some design, installation, and preventive maintenance considerations. Prior to light-off, says the author, chemical cleaning of the system should be undertaken to eliminate debris which may interfere with heat transfer and accelerate corrosion. Various solutions available for subsequent chemical treatment of circulating water are also suggested as a means of insuring satisfactory protection against corrosion.



1 OXYGEN-CAUSED corrosive effects increase rapidly with an increase in temperature, as shown here

tenance or failure to use chemical treatment as a matter of insurance.

How Corrosion Occurs

In hot water heating systems, circulating water may be heated to temperature as low as 120 F or as high as 250 F depending upon the design of the system and the building requirements.

Consideration of corrosion prevention must be given whether the system is steam or hot water, if satisfactory operation is to be assured. In hot water systems, corrosion is experienced on the water-side of the equipment when the water has corrosive characteristics at the temperatures at which it is used. Fig. 1 shows the effect of temperature on corrosion due to dissolved oxygen. Tht same marked effect of temperature is prevalent when corrosion is due to other causes such as low pH.

List Corrosion Factors

The factors which contribute to corrosion in heating systems may be summarized as follows:

1) Acidity (low pH due to carbon dioxide and/or decomposition of organic matter).

2) Dissolved gases (here, primarily oxygen).

3) Galvanic action (due to the presence of dissimilar metals).

Scale formation is rarely a major problem in hot water systems because there is no opportunity for concentration of solids, since there is no evaporation and virtually no makeup water. It is possible to predict the possibility of scale formation or acidic corrosion by application of Langelier's equations. Where such scale is encountered it will usually be present as calcium carbonate. The equations take into consideration pH, calcium, total alkalinity, dissolved solids, and temperature. Briefly, these equations permit the calculation of the pH at which the water is saturated with respect to calcium carbonate at the use temperature.

When the actual pH of water minus the pH of saturation is a positive value, the water is oversaturated with respect to calcium carbonate, and calcium carbonate scale will deposit on heating surfaces. If the pH of water minus the pH of saturation is a negative value, calcium carbonate scale will not form but some degree of acidic corrosion will occur.

Makeup Is Prime Cause

After a hot water system is filled with water usually no additional makeup water or only small amounts

need be added during the yearly operation. Under these conditions, scale formation normally is not a problem; however, corrosion may be experienced. The corrosion caused by dissolved oxygen in the primary fill is negligible. However, repeated introduction of makeup water as well as air infiltration at pumps, fittings, valves, vents, and the compression or expansion tank is of vital importance. In view of the numerous possible sources of oxygen contamination, careful design and installation, as well as adequate maintenance, is obviously vital.

Dissolved oxygen will attack ferrous metals causing corrosion in the form of pitting. This action by oxygen is accelerated by low pH caused by carbon dioxide and by increases in temperature. Normally, oxygen will produce an easily identifiable corrosion in the form of pits or depressions in the metal surface. As the corrosion attacks proceed, the pit will increase in area and depth.

A typical type of pitting attack is shown in Figs. 2 and 3. Since temperature plays an important part in accentuating the effect of a given amount of corrosion potential, the initial point of damage or failure will usually be found in the boiler shell or tubes because this is the point of highest heat transfer.

Corrosion Can Block Passage

Another characteristic of oxygen corrosion is the formation of a nodule or tubercule of magnetic oxide of iron over the pit cavity. Because the nodule possesses magnetic properties it can therefore be easily identified in the field without the necessity for a chemical analysis. If a nodule is powdered and placed on a sheet of paper, the finely divided material will follow the magnetic lines of force when a magnet is placed beneath the paper. This test is not infallible negatively, but a positive reaction to the lines of force almost certainly indicates oxygen attack.

The presence of corrosion from dissolved oxygen can be disastrous with respect to rapid failure of the system and expensive repairs. If the attack is allowed to proceed unchecked, difficulties may be experienced with impedance to heat transfer, water flow, and circulation long before an actual metal failure occurs.

Example Shows Problem

While it is not the intention of this article to dwell extensively on system design or maintenance, the following is offered as a case in point. It should be emphasized that the following discussion of design is for illustration purposes only and is not meant to convey any specific recommendations for general mechanical changes.

System corrosion, boiler tube failure, air venting problems and pump cavitation are costly conditions which can result solely from improper location of a compression tank. Clues that the tank is misplaced are erratic system operation, abnormal relief valve operation, water loss, air problems, noisy pumps and frequent makeup water requirements.

In evaluating the tabulated data in Fig. 4, it should be remembered that the pressure in the compression tank, or in a vessel at its point of connection to the system, is not influenced by circulating pump operation. Therefore, the compression tank pressure is always the same as the static pressure of the system. In consideration of the following facts, the system shown in Fig. 4 is prone to be contaminated by air to the degree that serious corrosion will result.

In this system, static head is 50 ft. Pressures in the boiler and compression tank are equal to this same value, while pressure at the air vent equals zero.

Assume the system resistance at required flow (or pump head at rated flow) to be 20 ft. The pump discharge pressure is fixed by the static head of the compression tank at 50 ft. Pump suction pressure is therefore 30 ft.

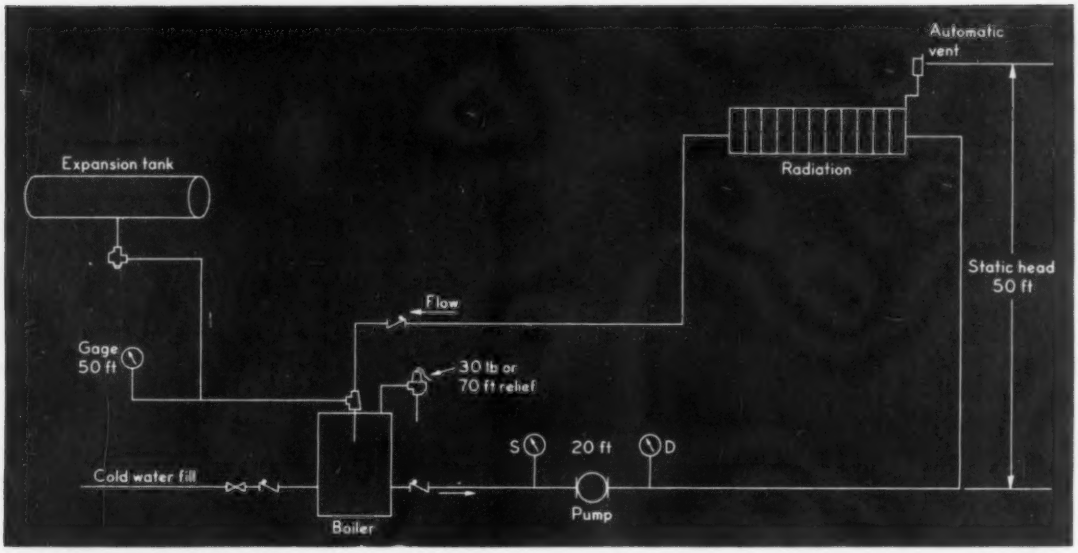
Since the head at the point of venting is 50 ft, the pump suction pressure of 30 ft will not provide for pressure at the vent. Therefore the vent will operate at a vacuum and will admit air.

To provide positive vent pressure during pump operation, static pressure must be increased by 20 ft (equivalent to pump head), so that the new static pressure is 70 ft.

Design Fosters Corrosion

When a system is operated under the above condi-

2, 3 TYPICAL PITTING due to oxygen corrosion is shown above and below



4 HOT WATER SYSTEM shown here is liable to oxygen corrosion because pump discharge pressure, which is fixed by static head of compression tank, does not provide pressure at vent, allows air to enter system

tions, air will enter at the vent and, in addition, cold makeup is added to raise the static pressure. A small amount of expansion will open the relief valve since the new static head of 70 ft eliminates the operating differential between the original 50 ft static head and the relief setting.

Additional makeup is needed as the system cools and a very undesirable cycle is created which will repeat indefinitely. The result will be continuous contamination with sizable quantities of corrosion oxygen.

The corrosion problem which is inherent with the system design shown in Fig. 4 could be alleviated by the use of a higher pressure boiler and relief valve, together with possible resizing of the compression tank. However, these changes could mean an appreciable increase in the cost of the system.

Reversal May Be Solution

A less expensive solution to the problem is shown in Fig. 5. The system arrangement is the same as that of Fig. 4, except that the flow is reversed. The static head on the pump suction will now be 50 ft. In combination with the pump head of 20 ft, the pump discharge pressure will now be 70 ft.

The vent will have a positive pressure and air intake at this point is eliminated. With the proper size compression tank a 30 psi relief valve can be used and raw water makeup will no longer be required.

Other situations in the system such as malfunctions of equipment and improper or negligent maintenance can cause symptoms similar to those described. These are mechanical types of difficulties that can always be policed and corrected, but trouble should not be a function of the basic design and will not be if the system has been properly engineered.

Chemical Cleaning Is Important

One important phase in the completion of a hot water heating installation is often neglected in the specifications — no provision is made for cleaning. The system is sometimes drained for changes and adjustments but never actually cleaned. Where the system uses steam, it is generally accepted that the boiler must be cleaned to remove oil and grease. If steam systems are not cleaned, they may become totally inoperative due to foaming. The necessity for cleaning hot water installations is not as obvious but is nevertheless as important for optimum results.

There are definite indications of an unclean hot water system. No matter how carefully installed, certain extraneous materials will find their way into piping, valves, boiler, etc. Pipe dope, cutting oils, soldering flux, dirt, sand, etc. are usually found.

Any suspended matter such as dirt or sand will contribute to the corrosion load due to the anodic - cathodic area created when these particles settle on metallic surfaces. When the circulating water is discolored or turbid, cleaning and flushing are obviously required. Due to the decomposition of organics or the action of bacteria, ignitable gases may be produced, in some instances accompanied by a decrease in pH value to the acidic range.

A system that has not been cleaned, and which tends to operate on the acid side will usually exhibit gas formation, pump seal and gland problems, air vent leakage, frequent relief valve operation and leaking pipe joints. Once in this condition, the symptoms

may continue for long periods unless corrected by cleaning. Sometimes an attempt is made to solve gas problems by the use of additional automatic air vents. Usually this procedure is not advisable since it may disturb the balance in the compression tank between the air cushion and water volume, as well as provide additional points of entry for air into the system.

If the system is permitted to deteriorate due to lack of cleaning, leaks will develop and makeup water requirements increase, with the result that sooner or later serious corrosion will be encountered from oxygen.

Cleaning Is Simple, Inexpensive

The cleaning of a hot water system, whether constructed of steel or copper piping, is neither difficult nor expensive. Common materials used for cleaning are trisodium phosphate, sodium carbonate and sodium hydroxide, and are normally available at most paint and hardware stores. Only one of these chemicals should be used, rather than a mixture.

The following solution strengths are suggested: trisodium phosphate - 1 lb/50 gal of water contained in the system; sodium carbonate - 1 lb/30 gal; sodium hydroxide - 1 lb/50gal. Actually, very acceptable results have been secured through the use of some of the well-known laundry detergents that are currently marketed. Also, a satisfactory cleaning agent is a 2 percent, by weight, solution of a surface active phosphate, such as sodium tripolyphosphate or sodium hexametaphosphate.

How To Use Solutions

The system should be filled with a solution of the chemical cleaning agent chosen, vented and circulated for several hours (a minimum of four hours is suggested). While circulating the cleaning solution, the system should be maintained at normal design operating temperature, if at all possible. After cleaning, the system should be drained, flushed, refilled with fresh water and placed in operation in the normal fashion.

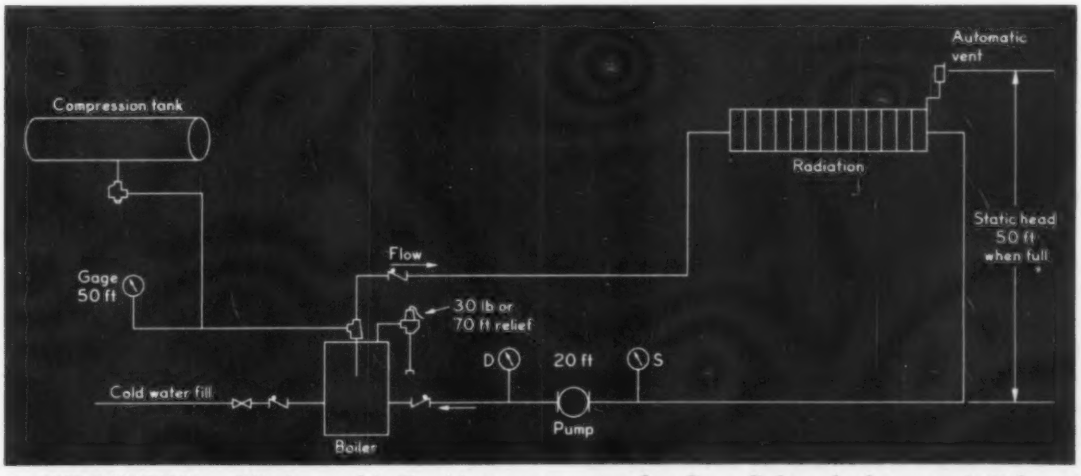
It should be especially noted that cleaning of radiant panel and snow melting systems is almost mandatory due to the large quantities of pipe involved. Similarly, systems which will use anti-freeze should always be cleaned. Otherwise, an anti-freeze may loosen debris in the system and cause a very material decrease in the rate of heat transfer if the suspended matter thus produced settles on the heating surfaces of boilers, convertors or heat exchangers.

Chemical Treatment is Good Insurance

One of the original concepts of chemical treatment to prevent corrosion involved an increase of pH to the alkaline range. However, it has been determined that in the presence of dissolved oxygen the pH must be increased to at least 11.0 to be effective. In systems where non-ferrous materials, such as copper, brass, bronze and aluminum are present, the maintenance of pH at this level can be damaging due to the reaction of these metals with the high alkalinity.

In recent years research has been directed toward the prevention of corrosion from acidity, dissolved oxygen and other causes by the use of inhibitors. These materials function to produce a barrier between metal surfaces and the corrosive elements present in the water. The chemicals used for this purpose are not consumed in the true sense of the word, but serve to render the metal passive to attack, and to maintain this resistance.

A program conducted under the auspices of The Steel Boiler Institute has resulted in the formulation



5 ONE SOLUTION to difficulty posed in Fig. 4 is to reverse system flow. Pump discharge head now equals 70 ft, vent has positive pressure and air intake is eliminated

of a buffered chromate type of treatment, which is specific for the prevention of corrosion in the boilers of steam heating systems. A polymerized alcohol type of antifoam is also incorporated to guard against foaming, since this formulation is employed in concentrations of 2000 to 3000 ppm in the boiler water.

Another formulation has been developed consisting of a nitrate - nitrite - borate - silicate mixture which is effective at 3000 ppm minimum. Both formulas give excellent corrosion protection even in steam heating systems that are saturated with oxygen. However, if a part of the corrosion is due to dissimilar metals (bi-metallic) then the nitrite formulation must be used in the range of 5000 to 7000 ppm.

Direct Treatment May Be Harmful

Based upon the above data, it would seem logical to directly apply these types of treatment to those systems using forced hot water. Unfortunately, the quantities of treatment employed in steam systems may cause operational difficulties in hot water systems, although the corrosion potential would be completely stifled.

Due to the concentration of treatment, problems develop due to crystallization of the treatment at points of close tolerance and where evaporation to dryness may occur. For example, the tendency for pump seals to evaporate water to dryness produces a crystal growth that may materially lower seal life.

The steps in order to properly protect a hot water system from corrosion are:

1) Proper design to exclude air contamination.
2) Thorough cleaning.
3) Carefully planned maintenance.
4) The use of relatively small amounts of inhibiting treatment for insurance.

The buffered type of chromate inhibitor, specially prepared for hot water systems, has been used for treatment with satisfactory results. Normally a concentration of treatment in the range of 150 to 250 ppm is employed. At this treatment level, the solids in the water are rarely high enough to cause any operational difficulties at such locations as pump seals, glands, etc.

Avoid Systematic Refilling

It is never desirable to drain and refill a hot water system periodically — for example, once per year. Normally, if the system has been properly installed, operated and chemically treated, it should not be drained and refilled unless repairs are necessary.

The above method of chemical treatment would appear to be one of the most feasible for the general treatment of hot water heating systems. Many other types of treatment are available but may possess some inherent disadvantages, such as a need for extremely low or extremely high concentrations, accurate feeding methods, periodic tests and handling hazards.

For these reasons, methods of treatment other than that described, are normally not employed, except in industrial plants where adequate facilities for handling and control are available.

Methods Are Not Universal

The nitrite base treatment mentioned for steam systems has not been suggested for general use in hot water systems. The use of rather high quantities of nitrite formulations would be required, thereby creating problems at points of total evaporation and close tolerances. In addition, sodium nitrite is a food for bacteria and, when retained for long periods of time in a closed system, troublesome biological growths may develop. Similarly, the use of soluble oils has been considered as a method of treatment, but the stability over long periods is questionable.

In the event a hot water system shows large amounts of air contamination, the air will be present because of inequities in design or operation. When it is not feasible to eliminate these causes there appears to be no alternative to using high concentrations of treatment, such as the amount of buffered chromate used in steam systems. It is recognized that this procedure will create some maintenance problems in many types of hot water systems but it would seem to be the lesser of two evils.

Anti-freeze Is Special Case

Some water systems, such as the snow melting type, will require the use of an anti-freeze. The common anti-freezes employed for this purpose are of alcohol or glycol base. Under no circumstances should a chromate type inhibitor be used in a system containing glycol. These chemicals are not compatible and are mutually destructive to one another.

Chromate may be used with methyl alcohol if the pH is maintained above 8.5. In the interest of simplicity, it is suggested that the operator purchase commercially available anti-freeze formulations which already contain a suitable corrosion inhibitor. However, most manufacturers of inhibited anti-freeze will recommend draining and refilling once per year to be sure of inhibitor stability.

The valuable assistance of the following in cooperating to prepare and submit data for this article is gratefully acknowledged:

The Babcock & Wilcox Co. Tubular Products Division

The Babcock & Wilcox Co. Research & Development Laboratory

Bell & Gossett Co. Engineering Department

The Steel Boiler Institute, Engineering Committee

the law and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

"Illegal Act" Contracts Can Be Enforced If Obstacle Can Be Removed

SOMETIMES parties will enter into a contract, only to later learn that because of circumstances beyond their control, one or both parties cannot perform the terms of the agreement.

Where performance of the terms of a contract would involve a violation of law, a suit for breach of contract will not be enforced. In other words, a person cannot promise to do an illegal thing and be held legally accountable when he refuses to do it.

However, the general rule does not apply where the impossibility created by law is only temporary, or where a change necessitated by law only makes the performance more burdensome or expensive. Such an exception is illustrated by the following case.

Y. Knott owned an apartment building and entered into a written contract with Yowill Heating Co. for the purchase and installation of a new heating plant. A clause in the contract read, "Buyer agrees to provide for heating plant a good and sufficient chimney."

On Sept. 26, Yowill Heating Co. applied for and received a permit from the municipal building inspector for permission to install the plant. The inspector visited the premises on Oct. 15 in his official capacity.

By then, the furnace had already been installed, and lacked only connection to the chimney, which extended down to the basement of the building.

The building inspector, upon examining the chimney, found it defective, and refused to permit the connection because of possible fire hazard. His recommendation was that a new chimney be built, after which the furnace could be connected without problem.

Knott refused to build a new chimney because of the added expense, and ordered Yowill's workmen off the premises. He also refused to pay for the plant, and Yowill sued.

Knott argued in court that it was the duty of Yowill to examine the chimney for suitability before starting installation. Also, he contended that since the law prevented a full performance of the contract (by not allowing the connection) he was excused from his part of the agreement.

Yowill's witnesses testified that it was not the custom in heating plant installation work of this kind to first inspect the chimney.

On the basis of custom, the court found that there was no implied obligation of Yowill to determine in advance the condition of the chimney.

"The furnace installed by Yowill," said the court, "can be used providing a new chimney is constructed. Contractually that obligation belongs to Knott. The contract itself is not illegal.

"The prohibition concerns an obligation assumed by Knott in relation to the chimney. That to do so may involve an expense not anticipated by Knott is a circumstance that should not act as a penalty to Yowill.

"Yowill has remained ready, willing, and able to complete his contractual obligation. The default lies with Knott."

The court's decision was not, of course, contrary to the general rule that a contract which requires an act prohibited by law will not be enforced.

Legal impossibility does not excuse performance so long as it lies within the power of the promisor to remove the obstacle to performance. ≠

Case History from a Consulting Engineer's Files

By C. T. BAKER
Consulting Engineer

Modern heating, piping, and air conditioning systems, for efficient and satisfactory operation, must be correctly designed. Here are typical cases from the author's experience where original designs were faulty and had to be corrected.

• the case of the low bidder

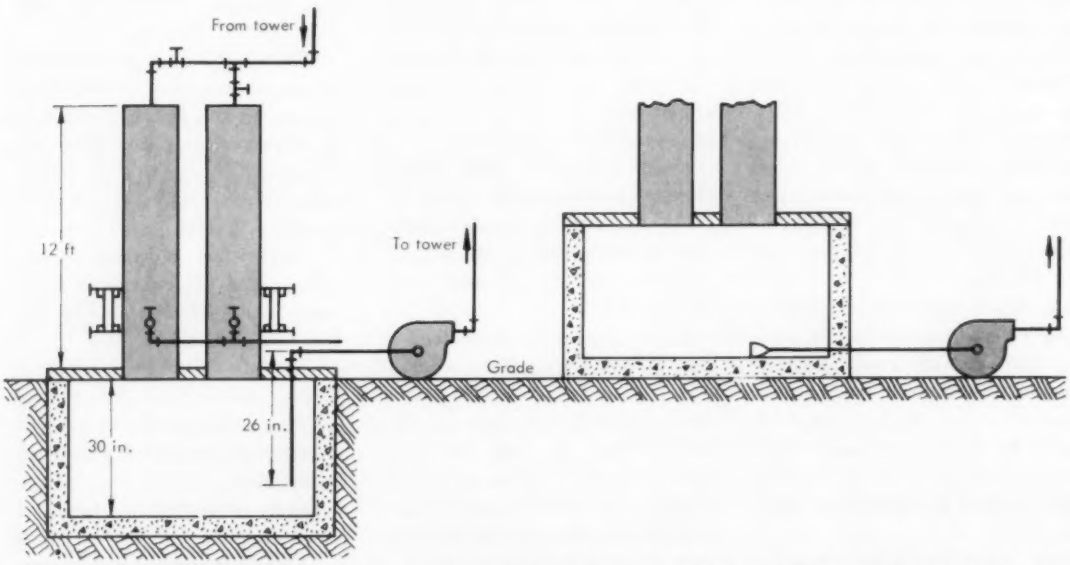
DURING the early 1930's, a certain business man decided to engage in the business of manufacturing ice.

He knew nothing about the process involved, and in requesting bids on the machinery installation and awarding contracts, he thought only in terms of first cost.

He awarded the installation job to the low bidder — a contractor who had submitted a proposal at $1200 less than the price of the next lowest bidder.

After operating the plant for a few years, the owner sold out to another organization. Shortly thereafter we were engaged to survey the whole plant, and to report our findings and recommendations as to what needed doing to put the house in order. We had an opportunity to examine the bids submitted to the original owner. The proposal of the low bidder told the story.

The items not included in the



1 CONDENSER INSTALLATION for ice manufacturing plant is shown at left. By locating basin above grade, as shown at right, 26 in. suction lift and extra foot valves could have been eliminated. Text tells of further shortcomings in design that made plant expensive to operate. The "low bid" was not the most economical plan in the long run

low bid, but included in each of the other proposals were

1) Liquid ammonia receiver

2) High pressure oil trap for the compressor discharge line

3) At least five manually operated ammonia stop valves

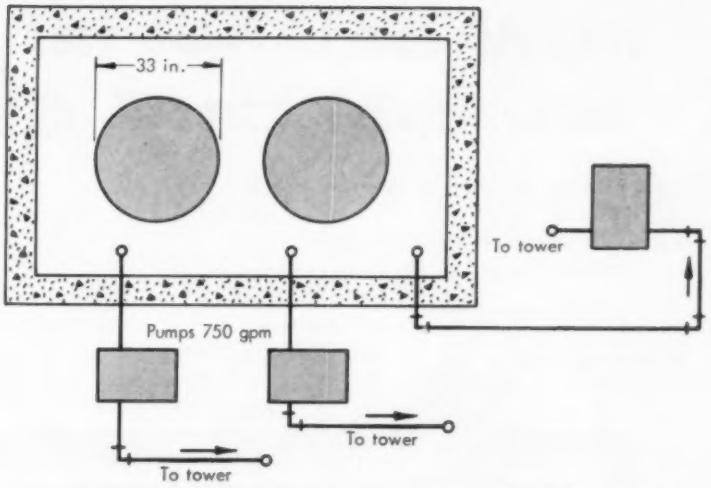
4) Suction line strainer for condenser water pumps

7) Volt meters for the d-c exciters

8) Pressure gage for the condenser water pump discharge outlet

9) The suction line was one pipe size too small

10) Cheap foot valves on the pump suction line, which did not provide valve openings equal to the area of the suction pipe.



2 PLAN VIEW of condenser installation shows arrangement of three centrifugal pumps with total capacity of 750 gpm. Only two were originally installed to handle maximum of 400 gpm. High condensing pressures made third pump necessary

The After Effects

It was revealing to check the operation of this plant after 10 years. Condensing pressures with the compressors operating at normal suction pressures were 215 to 225 psig.

The discharge gas temperature from the compressors, when operating at 23 to 25 psi suction and 215 psi condensing pressures, was 290 F. The reason for this was badly leaking compressor discharge valves and worn piston rings.

The average gage reading at the suction inlet to the condensing water pumps was 10 in. vacuum — because of the restricted foot valve openings and unnecessary right angle elbows in the suction line.

The overall length of the suction line (Fig. 1) including a 2 ft vertical lift, did not exceed 13 ft. Measurement of the power input to the pump motors disclosed that none of the three pumps (Fig. 2) were operating up to rated capacity.

As a matter of fact, the two 250 gpm pumps originally installed should have been ample for the requirements, which would not exceed 400 gpm.

However, since the summer condensing pressure was 225 psig or more, a third 250 gpm pump was installed in an effort to reduce condensing pressures. This helped some, but not much.

Unnecessary Lift

Fig. 1 shows how each of the three pumps was installed, with a vertical lift of 26 in. The type of condensers used could as easily have been installed as shown to the right of the Fig., eliminating the suction lift. This would also have reduced the pumping head, and eliminated extra foot valves.

The cost of later installing a 24 in. diameter by 14 ft liquid receiver with inlet and outlet valves, dual safety valves, and gage glass assembly, plus two 12 in. by 36 in. high pressure oil traps, a foul gas purger and necessary switchboard instruments, was considerably in excess of the difference between the original low bid and the more reasonable proposals which had been submitted.

In addition, the owners had been penalized by excessive power costs during all the years of operation at abnormally high condensing pressures, plus excessive pumping costs.

• the fractured pump casing

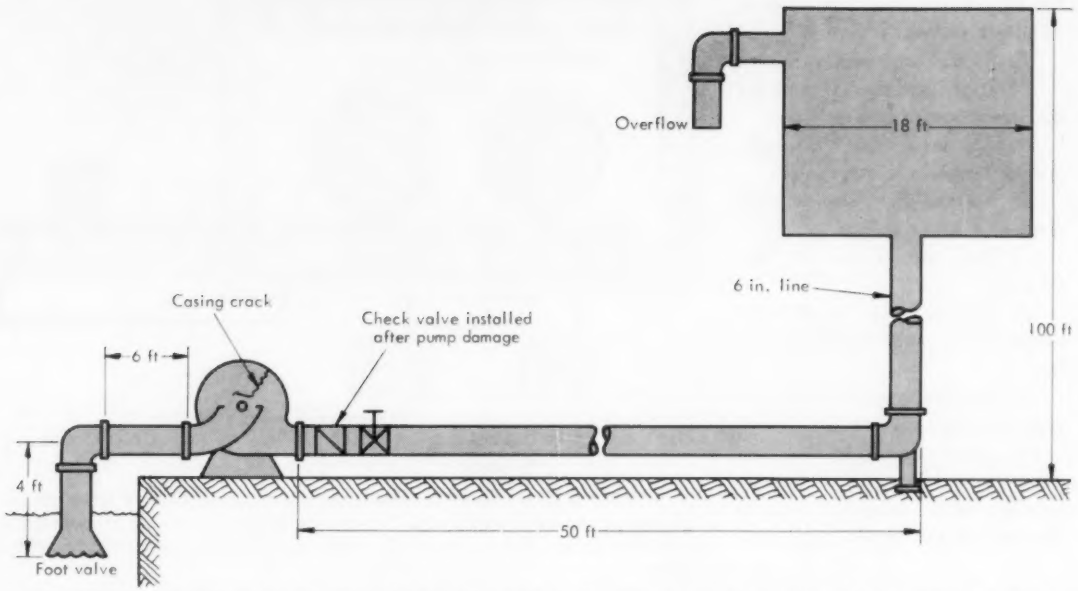
A 500 gpm center suction horizontal split case centrifugal pump, located near a lake and used to pump water to an overhead storage tank, had been in service about 10 days. The top of the storage tank was elevated about 100 ft above the ground.

A sudden power failure due to an electrical storm caused the pump motor to kick out and stop. When power was restored, a bad leak was discovered in the casing.

What Caused It?

To prevent a recurrence, a horizontal swing valve was installed in the pump discharge line close to the pump. The valve would absorb any hydraulic surges. Had this precaution been taken when the system was installed, a costly repair could have been avoided.

Without a check valve or other means of protecting a pump against an abrupt rise in pressure



3 CENTRIFUGAL PUMP failure occurred in this installation because no provision was made to protect unit against sudden hydraulic surges when power failure stopped the pump. Check valve installed later absorbs this sudden rise in pressure, which could well have been twice as great as the flow pressure, or more

within the system, such as is created by the sudden halt in the water flow from the pump, it may be accepted as fact that the pump will sooner or later suffer some damage.

It is not known what pressure was developed at the time of the casing rupture, since there was no pressure gage on the discharge outlet of the pump. However, the pressure at that instant could easily have been twice that of the flow pressure, or more.

Fittings such as check valves, manually operated stop valves, and others that may be subjected to heavy hydraulic shock or ram effect, like that developed in this case, should be of extra heavy construction. ⧺

Sam Lewis says:

"It Became Necessary to Install Positive Mechanical Damper Linkages"

In an important chemical laboratory three pneumatic dampers; *A* (outside air intake), *B* (exhaust), and *C* (recirculation) were supposed to be interlocked.

The contractor reported that when damper *A* was open, *B* was also open, and damper *C* was closed, as designed.

We found that with the elastic and rather gentle compressed air interlocking arrangement, and with the attachment of the damper motors to the ½ in. diameter damper shafts by small set screws, not one of the three dampers, *A*, *B*, or *C*, could be depended upon to perform its function.

As a result, the temperature of the air delivered by the fan was not controlled positively. It became necessary to install positive mechanical linkages between the three dampers, so that repeated episodes of wide room temperature fluctuation were ended.

In another large building, a thermostat in the supply air stream was intended to open damper *A*, in the outdoor air duct, and simultaneously to open damper *B* in the exhaust fan discharge duct, then to open damper *C* proportionally to permit recirculation of air from the exhaust duct to the supply fan.

In operation, it was discovered that dampers *A* and *B* would close nearly tight in response to the thermostat which was too cold, while damper *C*, several feet distant from *A*, did not open at all.

As a result, the volume of air available to the supply fan was restricted, and the whole system was rejected.

It should have been easy, in designing this system, to locate the three dampers in the three important ducts so that they could have been interlocked mechanically.

We approach the time when dampers in air ducts will be designed to close against seats, with gasket-like seals. ⧺

Check-List for Use With SMACNA Duct Manual

By HENRY J. COUCH
Executive Secretary
Ventilating & Air Conditioning
Contractors Association of Chicago

THREE ARTICLES by James H. Stiggleman in the November and December, 1959 and February, 1960 issues of Heating, Piping & Air Conditioning explained the nature and use of the "Manual of Duct Construction for Ventilating and Air Conditioning Systems," which had just been issued by the Sheet Metal and Air Conditioning Contractors National Association.

The manual was written with a minimum of "alternate methods" included, showing in most cases only the best and most economical duct designs. Others which were as good but unnecessarily costly, or cheaper but not consistent with good engineering practice, were deliberately omitted.

In certain instances, however, where local practices were very strongly divergent, and where cost and acceptability were comparable, alternates *were* included.

This inclusion of additional alternate details was required because of the variation in job conditions which would be met.

Access doors, for example, will differ if the fan housing is insulated or non-insulated. Standard or short radius elbows will be needed for various jobs, depending upon the availability of space. Air intake designs will often be determined by basic architectural features.

Such alternate arrangements, while they are limited in number, should nevertheless be noted on plans and in specifications.

To assist all concerned in making sure that no alternate is overlooked, the Ventilating and Air Conditioning Contractors Association of Chicago has prepared a "Check List for use with the Duct Manual for Ventilating and Air Conditioning Systems," as follows:

THE DUCT MANUAL was designed to simplify the work of the consulting engineer by eliminating the need for detailed construction drawings and specifications. It was recommended that the subject could be covered quite thoroughly in the Ventilating Specification with the statement, "Duct work shall be in accordance with the Duct Manual."

Experience has now demonstrated the basic validity of this recommendation. There are, however, certain items in the manual which must be referred to specifically in order to establish the consulting engineer's preference where an alternate exists.

Specific decisions relative to duct construction must be made by the engineer and should be set forth in the ventilating specification, under the 15 headings which follow:

1) **Recommended Gauges** — Table 1, page 9. Plates 5 through 14
   a) *Material to be used* — steel, aluminum or copper
   b) *Cross-breaking.* State whether or not cross-breaking is desired. (The number, size and spacing of joints and stiffeners is affected thereby.)
   c) *Longitudinal standing seams.* State whether or not to be used.
2) **Corner closures** — Plate 15, page 35
   a) *Specify whether or not required.*
3) **Hangers for ducts** — wall — Plates 16 and 17.
   a) *Specify type** — Band iron, shelf type or angle bracket
4) **Hangers for ducts—overhead** — Plates 18, 19 and 20
   a) *Specify type** — Band iron or trapeze
5) **Elbows** — Plate 21
   a) *Specify design* — standard radius or short radius
6) **Vaned elbows** — Plate 22
   a) *Specify vanes* — either single or double
7) **Tee Connections** — Plate 26
   a) *Specify type*
      1) 90 deg tap-in
      2) 90 deg straight with vanes
      3) Radius tap-in
      4) Radius tap-in on taper
      5) 45 deg tap-in
8) **Access doors (duct)** — Plates 30 and 31
   a) *Specify insulated or non-insulated*
   b) *Specify type* — hinged, sliding or removable
9) **Inspection plates and test holes** — Plate 32
   a) *Inspection plates* — specify screwed or sash locked.
   b) *Test holes* — specify pivoted, capped or plug type.
10) **Air intake or exhaust hood** — Plates 38, 39 & 40
   a) *Specify type* — Rectangular or goose-neck
   b) *If rectangular* — specify "standard" or "low silhouette."
11) **Belt guards** — Plates 41 & 42
   a) *Specify details*

HPAC DATA SHEET

PLATE NO. 50

ACCESS DOORS FOR CASINGS

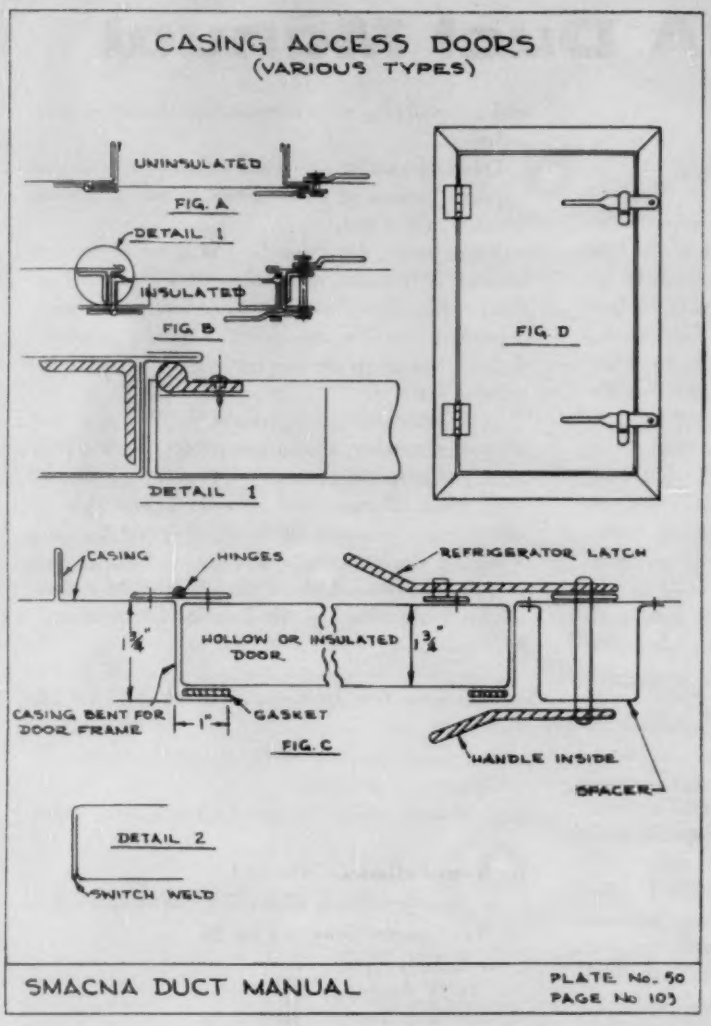


FIG. A – *CONSTRUCTION OF AN UNINSULATED DOOR*

The casing sheet is flanged inward and hemmed back to form the frame. The door is formed as shown to lap over the casing.
Hinges are installed on one side with latches on the other side, riveted or bolted in place. The gasket is installed on the door where door laps over the casing.

FIG. B – *CONSTRUCTION OF INSULATED DOOR*

The frame is formed separately and is locked to the casing as shown in "Detail 1". An angle is installed back of the frame, spot welded or riveted to the casing sheet, for reinforcing.

The door is made either of metal, filled with insulation, or it may be a wood core covered with metal.

The gasket is installed on the door as shown in "Detail 1".

Hinges are installed on one side with latches on the other side.

FIG. C – *CONSTRUCTION OF INSULATED DOOR*

The casing is flanged inward with a stop formed on inner edge to receive door. The gasket is installed on this stop.

The door is made of metal as per "Detail 2" and filled with insulation or it may have a wood core, covered with metal.

Hinges are installed on one side with latches on the other side.

FIG. D – *ELEVATION OF TYPICAL ACCESS DOOR SHOWING LOCATION OF HINGES AND LATCHES.*

Note: Latches should be of the wedge type to close doors tightly and with operating handles on both inside and outside of casings.

Hinges should have non corrosive pins.

TYPICAL PLATE from Duct Manual is illustrated above. Designer's decisions relative to possible alternates such as insulated or non-insulated, metal or wood core, should be set forth in specification

1) Expanded metal or solid
2) Split or one piece
3) Sheet metal or angle iron construction
4) Support from floor or from fan and motor

12) **Acoustical treatment** — Plate 44
   a) *State if required.*
   b) *Provide details* — performance, design, material, etc.

13) **Hangers for units** — Plate 46
   a) *Specify type** — rod, angle or band
   b) *Specify platform* — wood or steel
   c) *Specify vibration insulators* — if required and type

14) **Access doors (casings)** — Plates 50 and 51
   a) *Specify*
1) Insulated or non-insulated
2) All metal or wood core
3) As shown on Plate 50 or on Plate 51

15) **Fume hoods** — Plates 52, 53, 54, 55, and 56
   a) *Specify type*
1) Type A — open, no grease filters
2) Type B — double wall, no grease filters
3) Type C & D — open, with grease filters
4) Type E — double wall, with grease filters

If, in preparing a set of plans and specifications, these fifteen items are checked off, all other construction details of the system will be taken care of by the statement, "Duct work shall be in accordance with the Duct Manual." ∓

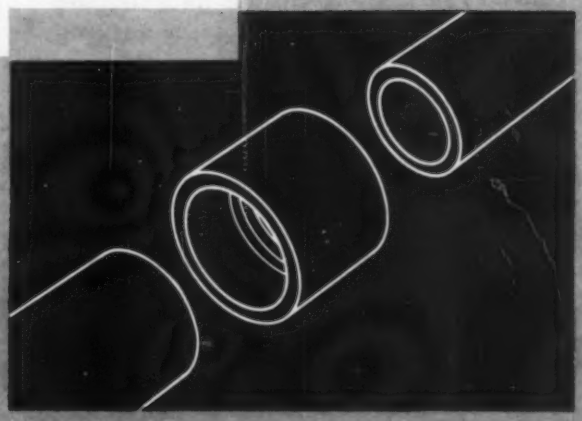
*Type is partially pre-determined by duct size. Some overlapping exists, however.

HPAC ENGINEERING DATA FILE

What You Should Know About

THERMOPLASTIC PIPING SYSTEMS

- *Kinds in common use*
- *Chemical resistance*
- *Physical properties*
- *How to apply them*



Consider These Factors In Design and Installation of Thermoplastic Piping Systems

SINCE its introduction in the United States, the use of plastic piping has grown rapidly both in quantity and in variety of application. Sales of plastic pipe have increased from a volume of $5 million in 1950 to an estimated $60 million in 1960. More importantly from an engineering standpoint, technological improvements have kept pace with the industry's growth and the products available today are in many cases superior to those available a few years ago.

New materials and new formulations of existing materials have extended the working range of plastic piping thereby eliminating some of the shortcomings of these systems. Additionally, progress has been made in standardization, the writing of materials standards, and in establishing testing procedures. This activity has provided the designer with much needed information and the assurance of quality and consistent piping materials.

With proper design, selection of material, and proper installation, the plastic piping system will outlast its metallic counterpart in many corrosive environments. It is this latter property that commends consideration of plastic piping and the one which has led to its acceptance as an important piping material in many industries and services.

Two Kinds of Plastic

Plastic piping materials are classified in two basic groups — thermoplastics and thermosets. Each has different properties and applications. The thermoplastics are distinguished by the fact that they can be repeatedly softened by an increase of temperature and hardened by a decrease of temperature without any appreciable change in properties. The change is substantially physical. Thermosets, on the other hand, become essentially infusible and insoluable once cured by the application of heat or chemical means. Their shape is fixed and it cannot be changed by the application of heat.

Commonly used thermoplastics include, polyethylene (PE), acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC), and cellulose acetate-butyrate (CAB). Letters in parentheses are common abbreviations in accordance with ASTM D 1600[1]. Some of the relatively new thermoplastic piping materials include chlorinated polyether, polypropylene, polyvinyl dichloride, and polyacetal. Others which find limited use at present in solid plastic piping are polytetrafluoroethylene (PTEE) and polyvinylidene chloride (saran). These are used more extensively in lined steel pipe.

Three resins presently used in the manufacture of reinforced thermosetting plastic pipe are[2] polyester, epoxy, and phenolic. The strength and resistance to temperature of this type of pipe depends upon the reinforcement. Reinforcing materials vary but the most common is glass fiber. The reinforced thermosetting pipe has greater

[1]*Numerals refer to references on page 142.*

COVER PHOTO: PVC pipe lines lead to thickener tanks in a uranium concentrating plant. The lines carry a corrosive sulfuric acid solution used in process which extracts uranium oxide. Photo courtesy of B. F. Goodrich Co.

Thermoplastics have rapidly gained acceptance as important construction materials for piping systems in many process industries. High chemical resistance primarily has been responsible for the increasing usage of thermoplastic piping in such installations. This property leads to low long term costs, freedom from product contamination, and low maintenance requirements.

Low strength and limited heat resistance as compared to metals limit the application of thermoplastics. However, a working knowledge of these properties and their effect on design permit utilization of the favorable chemical resistance in a majority of piping applications. Additionally, new material developments continue to broaden the range of temperatures and pressures over which they can be successfully applied.

In this report, the properties of commonly used thermoplastic piping materials — including those for two newcomers — are presented together with pointers on how to utilize them in design and installation.

strength and heat resistance than most thermoplastic pipe but at present it constitutes a very small part of the plastic pipe installed. However, its use is increasing, especially in chemical plants.

The remainder of this report is devoted to thermoplastic piping. However, both thermosetting plastic piping and plastic lined piping have an important place in corrosion resistant piping systems and will be considered in detail in a future report.

Consider These Advantages

The advantages of thermoplastic piping materials which have lead to their acceptance include:

- Corrosion resistance — They resist chemical attack by a broad range of inorganic and certain organic compounds and do not suffer galvanic corrosion because they are nonconductors. Due to the absence of corrosion products, when properly applied, they do not contaminate process fluids. External corrosion is also eliminated in corrosive environments thereby eliminating the need for protective coatings.
- Low friction factor — The smooth interior surface of plastic piping results in low pressure drops per foot and its low fouling tendency keeps it low.
- Light weight — Low densities and corresponding light weights result in savings in installation and transportation costs.
- Low thermal conductivity — High resistance to heat flow provides a degree of self insulation which may be adequate in some instances to eliminate the need for insulation.
- Low relative cost — In relation to other materials, especially high alloys, for comparable service, commonly used thermoplastic piping is lower in both initial and operating costs.

Weigh Disadvantages Too

Balanced against the advantages of plastic piping are several shortcomings related to its plastic nature. When these limitations are considered carefully in design, they do not prevent utilization of the many advantages though they do establish limits of application. The disadvantages are:

- Limited resistance to temperature — Decrease in mechanical properties occurs with increase in temperature. Also, chemical resistance is sometimes adversely affected by high operating temperature.
- Low mechanical strength — The strength of plastics is much below that of metallic piping materials. However, the strength to weight ratio is higher for plastics, though this is not necessarily used to advantage as wall thicknesses generally conform to those of metal or are lighter.

● High coefficients of thermal expansion — High expansion rates require consideration in design and provision to take care of expansion.
● Poor resistance to physical abuse and fire — The strength of plastics, in general, decreases with surface abrasions, etc., however, reasonable care in handling will eliminate this problem. Fire will deteriorate all plastics commonly used in piping systems. Some burn slowly, others are self extinguishing.

The remainder of this report is devoted to how best to utilize the advantages of plastic piping while minimizing the effects of the disadvantages, in design, installation, and operation.

Thermoplastic Piping Materials

Of the several thermoplastic piping materials in common use, polyethylene commands the greater share of the dollar volume. Polyethylene was first extruded into piping in 1948. The base resin is made by polymerization of ethylene gas and today is available in three types. These are identified as low, medium, and high density polyethylene. Low density polyethylene is the most common and the first to be used for piping. The more recently developed medium and high density or linear polyethylenes have greater strength and resistance to abrasion and temperature, but lower impact strength than the conventional low density resins. Polyethylene piping is black in color due to the addition of carbon black to improve resistance to weathering.

Pipe is extruded from both virgin polyethylene and from "reprocessed" material. Only pipe made of virgin polyethylene is approved by the National Sanitation Foundation (NSF) for carrying potable water. The lower grade reprocessed materials are suitable for nonpressure applications, but for installations requiring optimum strength and chemical resistance only that extruded from virgin polyethylene should be used. Polyethylene piping is most commonly used for carrying water at moderate pressures and temperatures below 120 F. It has been used with varying degrees of success in radiant heating systems and has found some application for ice skating rink piping. Because of its low cost and chemical resistance, polyethylene is an excellent material for corrosive waste drainage piping under no load and at low temperature.

Two Types of ABS Piping

Acrylonitrile, butadiene, and styrene — ingredients used in making synthetic rubber — are the primary constituents of the ABS polymers. They are sometimes referred to as styrene copolymers or resin rubber. Piping made of two types of ABS are available. Both types are rigid, have high impact strength, are tough and have relatively high heat resistance among the various thermoplastics.

Type II ABS, the newer of the two styrene copolymers, has lower impact strength but greater tensile strength and heat resistance than Type I. ABS II piping has an upper operating temperature of 180 F at no load. It is supplied in either blue-gray or black color. Principal uses have been in the chemical and food processing industries, for carrying potable water (NSF approved), and for gas transmission piping. ABS piping is second to polyethylene in volume used.

Rigid PVC Use Growing

Rigid or unplasticized polyvinyl chloride piping is third in volume installed and its use is growing in relation to other thermoplastic materials. PVC is made by chlorination of acetylene gas. PVC is a rigid material, gray in color (Type I PVC is dark gray, Type II is light gray), heavier and stronger than most other thermoplastics and has good abrasion resistance. Two types of PVC are used as piping materials. Type I or normal impact PVC has the greater tensile strength and greater chemical and temperature resistance but relatively low impact strength even at room temperature. A rubber modifier is added to make Type II or high impact PVC which increases the impact strength. Type I PVC is usually limited to service at 150 F while Type II is limited to operation at 140 F.

PVC has generally good chemical resistance and finds application in chemical and food processing industries. It is also used for water services, and has proved to be satisfactory for industrial and laboratory waste drainage.

Cellulose Acetate Butyrate

Cellulose acetate butyrate material is made from cellulose, acetic acid, and butyric acid. It is commonly called butyrate pipe. CAB is a glossy black rigid pipe with medium strength and low chemical resistance. It has a recommended maximum operating temperature of 140 F. Principal uses have been in refinery piping for carrying crude oil, natural gas, and salt water disposal lines. Resistance to paraffin build-up and attack by aggressive oils are what make it attractive for refinery piping.

Chlorinated Polyether

Chlorinated polyether is a new thermoplastic now available in extruded pipe. The material is made by polymerization of chlorinated oxetane. About 46 percent of this polymer by weight is chlorine. It has a medium tensile strength, high chemical resistance, and high resistance to temperature. Valves molded of this material are recommended for service temperatures as high as 300 F with low pressures. Extruded piping and molded fittings have recommended service temperatures of 250 F at no load. As it is relatively new, little field experience has been reported for pipe of this material. Anticipated uses include services where its high chemical and heat resistance can be used to advantage.

Polypropylene

Polypropylene — polymerized propylene gas — is another recent development and is a member of the same family as polyethylene. However, it has a lower density than polyethylene, but higher strength and heat resistance. Potential maximum operating temperature is 185 F though this as well as its strength and corrosion resistance must yet be confirmed by field tests. Valves and fittings molded of polypropylene are commercially available. Joined by thermal fusing, it has been used in some early applications for salt water disposal lines, crude oil gathering lines, and underground conduit piping. It is expected to be suitable for waste drainage piping and is being studied for use as gas distribution and pressure piping for industrial processes.

Corrosion Resistance is Primary Attribute

Because plastics are nonconductors, they are not subject to either electrochemical or galvanic corrosion — the common forms of metallic corrosion. Instead, the corrosion mechanism is identified as "absorption" of the attacking chemical by the plastic material. Thus, the corrosive attack alters the material and is indicated by a change in appearance and/or mechanical properties. Since there is no pitting, erosion, etc., associated with corrosion of metallic piping, there is no loss of material to contaminate the media being carried or to cause fouling of the piping, valves, etc.

Laboratory tests of corrosion resistance are often made with a tensile strength sample under controlled temperature and carried out for at least 30 days. The effects observed in such tests can be described as follows:[3]

1) Complete failure is indicated by:

a) Complete solvation — results when thermoplastic materials are exposed to strong organic solvents.

b) Softening and swelling — caused by weaker solvents.

c) Resin breakdown — reactive chemicals alter molecular structure.

d) Stress cracking — may be observed with chemicals which have little or no effect when a sample is in an unstressed condition. Residual stresses from extrusion are sufficient to cause cracking when exposed to stress cracking agents.

High density polyethylene and ABS II are most subject to stress cracking.

2) Partial attack is indicated by:

a) Limited losses in strength.

b) Changes in weight — plastics generally show weight gain when attacked.

3) Complete resistance is indicated when no changes in properties occur.

Chemical resistance tests have been conducted with a large number of reagents. These are given in manufacturer's literature and reference should be made to these listings when selecting a piping material. A limited listing of corrosive media and the resistance of various thermoplastic piping materials to them is given in Table 1. It should be noted that resistance is indicated for two temperatures — 75 F and the recommended maximum operating temperature. In some cases, a material resists attack at 75 F but does not perform well at the limiting temperature.

The convention adopted in Table 1 is to indicate those combinations of temperature, material, and chemical showing excellent resistance. The dash indicates something less than complete resistance, or complete failure. In some cases, a material may perform satisfactorily even though complete or excellent chemical resistance has not been indicated in Table 1.

The resistance of two steel piping materials — low carbon steel and type 316 stainless steel — are also indicated. It will be noted that the plastics complement these metals and a more complete comparison[4] of the resistance of various metallic piping materials shows this to be true for metals and plastics, in general.

Check Corrosion Resistance in Field

Reported resistance to corrosion is usually based upon laboratory tests and when possible confirmed by field tests. However, such recommendations must be qualified to the extent that field conditions often differ from the carefully controlled laboratory test. Thus, it is well worth while to test a pipe material in the environment and service it must perform to be certain of satisfactory results. A short exposure is usually sufficient for such field tests, as failure occurs in a relatively short period of time if it is going to occur. When testing samples in existing metallic piping installations, it is important to install the plastic section so that it does not have to carry the full burden of expansion induced stress in the system to prevent failure due to excessive stress from being misinterpreted as poor chemical resistance.

Check Specific Formulation

Field tests have shown that chemical resistance may vary with different formulations of the same basic material. Extrusion lubricants, extrusion techniques, and stabilizers can impair corrosion resistance. This was illustrated by field tests[5] of

TABLE 1 — RESISTANCE[1] of thermoplastics to attack by various chemicals is given here. Note that temperature decreases resistance of some materials to various reagents

Chemical		ABS Type I		ABS Type II		CAB		PE		PVC Type I			PVC Type II		Chlorinated polyether			Polypropylene		Low carbon steel	Stainless steel 316
	Temperature, F	75	160	75	170	75	150	75	140	75	140		75	140	80	150	200	80	185		
Acids																					
	Hydrochloric 10%	●	—	●	●			●	●	●	●	●	—	●	●	●	●	●		—	—
	35%			●	●			●	●	●	●	●	●	●	●	●	●			—	—
	50%			●	●			●	●	●	●	●	●	●	●	●	●	●	●	—	—
	Sulfuric 10%	●	●	●	●	—	—	●	●	●	●	●	—	●	●	●	●	—	—	—	—
	80%	—	—	—	—	—	—	●	—	●	●	●	—	●	●	●	●	●	—	—	—
	98%	—	—	—	—	—	—	—	—	●	—	—	—	●	●	—	—	●	—	—	—
	Nitric 10%	—	—	●	—	—	—	●	●	●	—	—	—	●	●	●	●	●	—	—	●
	70%	—	—	—	—	—	—	●	●	—	—	—	—	●	—	—	—	—	—	—	●
Bases																					
	Ammonium hydroxide	●	—	●	●	—	—	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Calcium hydroxide	●	—	●	●	—	—	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Sodium hydroxide	●	—	●	●	—	—	●	●	●	●	●	●	●	●	●	●	●	●	—	●
Organics																					
	Ethylene glycol	●	●	●	●	—	—	●	●	●	—	●	●	—	●	●	●	●	●	—	—
	Formaldehyde	●	●	●	●										●	●					●
	Ketones	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Salts																					
	Calcium chloride	●	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	—	—
	Sodium chloride	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	—	●

[1] ● resists attack, — limited resistance or complete failure.

the resistance of 6 different Type I PVC pipes to a 93 percent sulfuric acid solution. Of the six tested, only one proved resistant to the acid. This has led to differentiation in the recently approved ASTM D 1784-60T between high and medium chemical resistance formulations for rigid PVC compounds.

Weathering May Cause Problems

While plastics are resistant to many chemicals, some are subject to accelerated deterioration[4] when exposed to combined effects of sunlight, oxygen, and water. This is referred to as weathering and its effect is reduced strength and ductility. Principal cause of weathering is photo-oxidation due to ultra-violet radiation. Resistance to weathering is achieved by the addition of carbon black or other opaque additives which serve as light screens. Polyethylene, in particular, is subject to light degradation and its characteristic black color is due to the addition of carbon black. Newly discovered[6] sulfur containing organic chemicals act as thermal antioxidants when combined with carbon black. These, it is reported, are highly effective in protecting polyethylenes against the effects of heat. Rigid PVC and chlorinated polyether do not suffer from weathering effects.

Resists Aggressive Soils

The excellent chemical resistance and low electrical conductivity of thermoplastics makes them particularly suitable for underground pipelines. They have been used extensively because of this for buried water and gas service lines. Their use eliminates the necessity of external coatings or cathodic protection systems which would be necessary in aggressive soils. The resistance of PVC piping in such circumstances was demonstrated[7] when a 20 year old buried pipeline in Germany was dug up. Samples taken from the pipeline were tested and no change in mechanical properties of the PVC could be detected. This pipeline had been in continuous service for 20 years.

Properties of Thermoplastic Piping Materials

A working knowledge of the mechanical and thermal properties of thermoplastic piping materials is essential to their successful application. Typical properties for commonly used thermoplastics and two of the newcomers are listed in Table 2. The values, in general, represent averages of the properties listed by several manufacturers of each type of pipe. It should be noted, however, that in many cases the properties are those for samples of the basic resin rather than the piping itself. Thus, the values given in Table 2 and values measured for a specific make of pipe may differ due to the effect of extrusion techniques, extrusion lubricants, and stabilizers on the finished product.

Material specifications for several of the thermoplastics have been prepared by ASTM. These give minimum values of several properties of molded samples of the various formulations used in tubing and piping. The values given in ASTM standards are not intended for use in design, however, and reference should be made to manufacturer's literature for properties of specific materials. The ASTM standards covering these materials and others relating to plastic pipe are listed in Table 3. Since it is desirable to minimize variations in measurement of the various physical properties to permit comparison of materials, ASTM test procedures have been adopted. Applicable test procedures are given in Table 2.

Wide Range of Tensile Strengths

It will be noted in Table 2 that the mechanical properties of thermoplastic piping materials are low in relation to metals. Also, there is a relatively large difference in the strengths of the various thermoplastics. The tensile strengths given in Table 2 are based upon short term tests.

The short time tensile strength of plastic pipe is best determined by quick burst tests (ASTM D 1599-58T) and application of Barlow's for-

TABLE 2 — TYPICAL PROPERTIES of thermoplastic piping materials at 75 F unless noted otherwise are listed here

Property	ABS		CAB	PE			PVC		Chlorinated polyether	Polypropylene	ASTM Test No.
	Type I	Type II		Type I	Type II	Type III	Type I	Type II			
Specific gravity	1.06	1.08	1.20	0.910-0.925	0.926-0.940	0.941-0.965	1.38	1.35	1.4	0.905	D792
Tensile strength, psi	5000	8000	5500	1400	2000	3500	7000	6000	6000	5000	D638
Maximum working stress, psi	1000	1700	850	385	510	600	1200	1000	1250	1000	
Flexural strength, psi	8000	12000	6200	..	..	..	14000	11000	5000	..	D790
Modulus of elasticity, psi $\times 10^{-5}$	2.4	3.5	1.35	0.35	0.55	1.1	4.15	3.5	1.6	1.75	D638
Izod impact strength, ft lb/in. notch	5-10	4.5	2.1	3	16	1.5-5	0.5-1.5	6-20	0.4	1	D256
Thermal conductivity, Btu/hr/sq ft/F/in.	1.0-2.6	1.5	1.1-2.2	2-2.5	1.7-2.0	3.2-3.7	1.02-1.06	1.31-1.80	0.91	1.21-1.36	
Coefficient of expansion, in./in. $\times 10^5$	5.5	5.6	6-10	8	10	6-11	2.9-4.0	4.7-7.8	4.4	5.8	D696
Heat deflection temperature, at 264 psi fiber stress, F	188	225	150	—	—	—	157-165	150-157	185	140	D608
Maximum recommended operating temperature, F	170	180	140	120	120	120	140-150	130-140	250	185	

mula for hoop stress. This is common practice and is desirable because of the effect of pipe size, and geometry on the burst strength. Barlow's formula relates burst pressure and stress as follows:

$$P = 2t\ S_T/D_o$$

where:

P = internal pressure, psi
t = wall thickness, in.
S_T = hoop stress, psi
D_O = outside diameter, in.

The instantaneous burst strength is used as an indication of quality but because of creep associated with the viscoelastic behavior of plastics it has limited value in determining long term allowable stresses.

The factors[8] which control the amount of stress relaxation or creep taking place and the relative importance of viscous properties as opposed to elastic properties are the magnitude of the stress, the length of time the stress is applied, and the temperature of the pipe. An increase in any of these variables increases the rate and amount of creep with resultant decreases in the resistance of the material to loading.

The effect of two of these variables — temperature and stress — on creep in chlorinated polyether after a constant load has been imposed for 10,000 hrs is shown in Fig. 1. This is a typical example of this phenomenon which is exhibited by all thermoplastics. The curves on which Fig. 1 is based[9] indicate that the creep has reached a maximum value for each combination of temperature and stress. Thus, a working stress can be determined which will be within the limits for an acceptable amount of creep. The maximum working stress for one available pipe of this material is based upon a maximum permissible creep of 2 percent at 10,000 hrs.

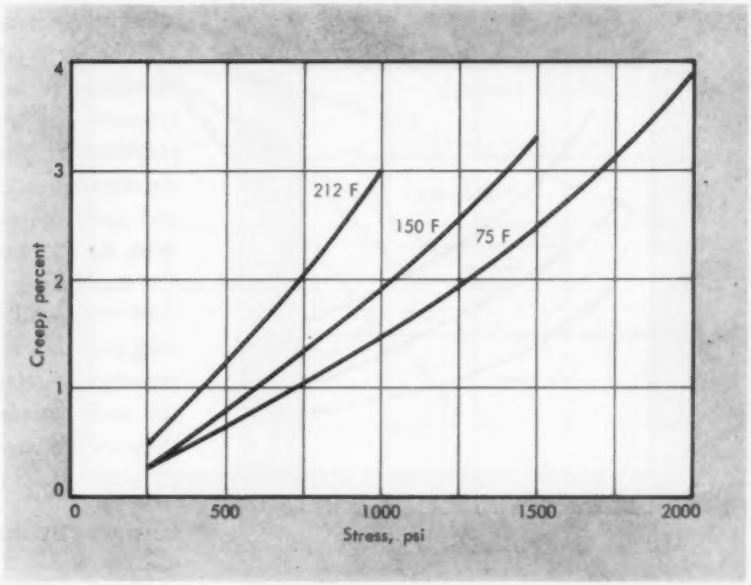
The effect of time and the magnitude of the stress on the burst strength (hoop stress) of typical[10,11] polyethylene materials at 75 F is shown in Fig. 2. Note that as the applied stress decreases, the time to failure is increased until a stress is reached at which the pipe will perform without failure for an indefinite period of time.

Working stresses conventionally have been established on the basis of an apparent 5 to 1 safety factor on instantaneous burst strength data. This apparent factor of safety is high when long term performance is taken into account. For

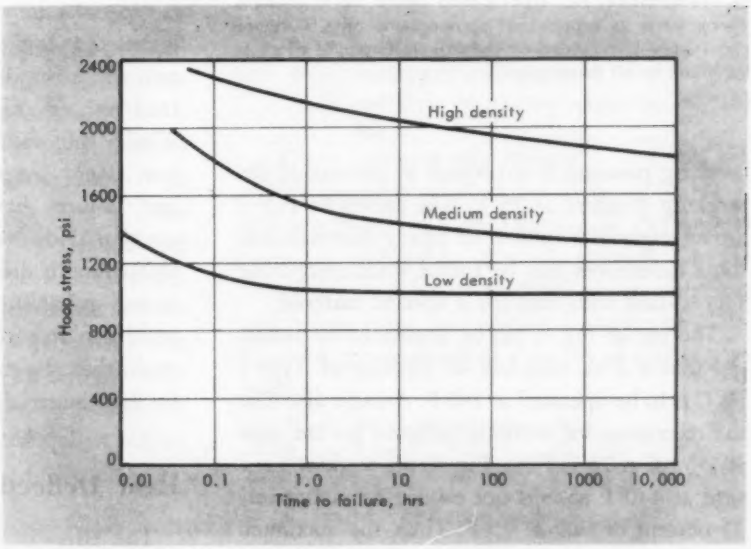
TABLE 3 — ASTM STANDARDS pertaining to thermoplastic piping materials and thermoplastic pipe are given here

Polyethylene Molding and Extrusion Materials	D1248-60T
Rigid Polyvinyl Chloride Compounds	D1784-60T
Rigid Acrylonitrile-Butadiene-Styrene (ABS) Plastics	D1788-60T
Cellulose Acetate Butyrate Molding and Extrusion Compounds	D 707-55T
IPS Rigid (Polyvinyl chloride) (PVC) Plastic Pipe	D1785-60T
IPS Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe	D1527-58T
Solvent Welded (SWP Size) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe	D1528-58T
Solvent Welded (SWP Size) Cellulose Acetate Butyrate Pipe	D1503-57T

Copies of these standards are available from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.



1 CREEP or cold flow in thermoplastic materials is increased by time, temperature, and stress. Effect of temperature and stress on creep at 10,000 hrs in chlorinated polyether is shown here. This is typical of this phenomenon in all thermoplastics



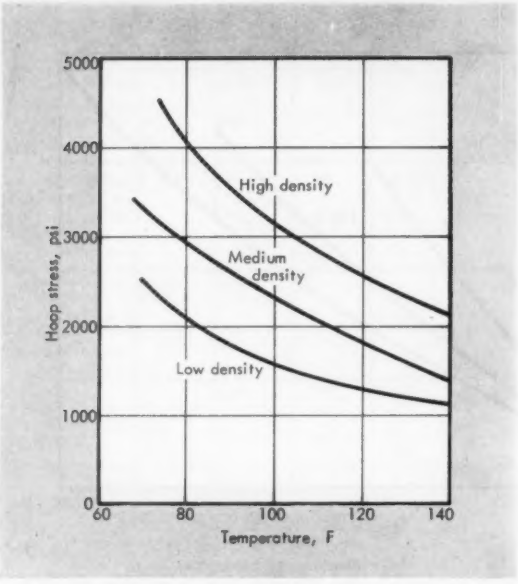
2 BURST STRENGTH (hoop stress at rupture) of thermoplastic piping decreases with time load is applied in manner similar to that shown here for three types of polyethylene at 75 F. Working stress is based on similar long term tests and is set below minimum values shown by curves

low density polyethylene, the maximum recommended working stress on this basis is about 380 psi. The actual factor of safety based upon the 10,000 hr data of Fig. 2 is 900/380 or 2.47 to 1. Reductions in the apparent safety factor based on short time tensile strength are experienced with all thermoplastic materials.

Temperature Reduces Burst Strength

Temperature also affects creep and the resistance to loading. The effect of temperature on the hoop stress at rupture of typical polyethylene materials is shown in Fig. 3. As the temperature of the piping material increases, the quick burst strength or hoop stress at failure decreases sharply. This must also be taken into account in design to avoid early failure of a piping system and is considered in manufacturer's recommendations.

The behavior shown in Fig. 3 for polyethylene is exhibited in varying degrees by other thermoplastics. The relationship of working pressure or strength, and operating temperature is given in Fig. 4 for the materials considered here. The



3 TEMPERATURE DECREASES quick burst strength (hoop stress at rupture) of thermoplastic pipe. Data for three types of polyethylene shown here is typical of effect exhibited by all thermoplastics

working pressure is expressed in percent of the working pressure at 75 F. The curves of Fig. 4 are averages of a number of piping materials and some differences may be found when comparing Fig. 4 data with that for a specific material.

The use of Fig. 4 can be illustrated by assuming that a 2 in. schedule 40 pipeline of Type I PVC is to be operated at 140 F. Assume also that the recommended working pressure for the pipe is 155 psi at 75 F. From Fig. 4, the working pressure at 140 F should not exceed approximately 55 percent of that at 75 F. Thus, the maximum pressure for which the line should be designed is 0.55 × 155 or 78 psi.

What Allowable Pressure?

Comparison of working pressures based upon working stresses in Table 2 with those recommended by various manufacturers reflect varying degrees of conservatism as well as variations which arise from differences in manufacture. For some materials, the recommended working pressures differ by a factor of two. However, the highest values are usually referred to as suggested maximum operating pressures and, in some cases, it is suggested that working pressures be set at 60 to 70 percent of the maximum recommended. Some standardization of working pressures has taken place — the pressures for polyethylene piping, for example, have been standardized in Commercial Standard CS-197-60, and those for polyvinyl chloride in CS-207-60. With the adoption of long term testing as a basis for establishing working pressures, the differences now existing should be minimized. Until long term data is available, unduly high working pressures in relation to those for other pipe of the same material or recommended working stress should be used with care.

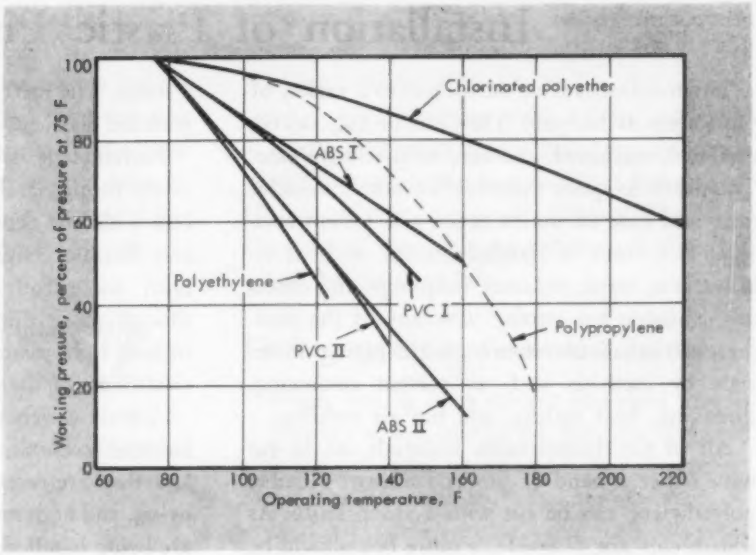
Impact Strength

Impact strength is a measure of toughness and is especially important when the piping is to be installed at low temperatures. The notched Izod test, which is more indicative than the unnotched Izod test, is used to measure impact strength. While the values for plastics are generally low, field experience[3] has indicated that few failures have resulted from low impact strength. However, when the notched Izod impact strength drops below 3, care should be exercised in handling and installation to avoid any problems. Impact strength at low temperatures establishes the minimum operating temperature for each material.

Heat Deflection Temperature

The effect of operating temperature on mechanical strength was discussed earlier. Heat deflection temperature is another measure of the resistance of plastics to heat. This is the temperature at which a test specimen deflects when subjected to a constant stress. The deflection temperature is usually reported for an imposed fiber stress of 264 psi though values are sometimes reported at 66 psi. Recommended maximum operating temperatures are usually set 10 to 20 F below the deflection temperature.

With adequate support and a reduction of working pressure, however, higher operating temperatures have been successfully handled. This is especially true when the flow temperature does



4 REDUCTION of working pressure of thermoplastic pipe at various operating temperatures is shown here. Working pressure at any operating temperature is obtained by multiplying working pressure at 75 F by factor from curve

not remain constant but varies cyclically with time so that the lowest flow temperatures are below maximum recommended values.

The maximum temperatures at which thermoplastics will perform satisfactorily range from 120 to 250 F. This range has just recently been widened with the introduction of ABS II and chlorinated polyether piping. It is anticipated that further improvements in resins and the development of new polymers will extend this range even further. As noted earlier, the reinforced thermosetting plastics and certain plastic lined steel piping have performed well at higher temperatures.

Must Consider Thermal Expansion

The thermal expansion coefficients of plastics range from 5 to 20 times that of steel. Because of this, it is essential that provision for expansion be made in design. Two factors tend to compensate for the high coefficient of expansion. One is the limited temperature range over which plastics can be applied. The other is the low moduli of elasticity[3] which allow the piping to assume expansion without inducing excessive stresses. The thermal stresses induced in restrained piping can be estimated by the following formula:

$$S = E n \Delta T$$

where:

S = induced stress, psi
E = modulus of elasticity, psi
n = coefficient of thermal expansion, in. per deg F
ΔT = change in temperature, F

The modulus of elasticity given in Table 1, which is based upon short term tests, is of limited value in computing thermal stresses. Due to creep, the modulus of elasticity varies with time and temperature, and plastics designers have defined[12] a time dependent modulus of elasticity as follows:

E_t = initial stress/strain at time t

$$E_t = S_o / e_t$$

where:

E_t = time dependent modulus, psi
S_o = initial stress, psi
e_t = strain at time t, in. per in.

Values of the time dependent modulus are calculated from experimental creep data such as that given in Fig. 1. These values are then used to calculate the strain for any given combination of time and temperature.

Low Thermal Conductivities

The thermal conductivities of plastics are much lower than those of metals — about 1/300 of those for mild steel and 1/800 of that for stainless steels. In some instances, this property may eliminate the need for insulation.

Installation of Plastic Piping

Thermoplastics lend themselves to a variety of fabrication techniques. They can be cut, sawed, threaded, machined, and bent with relative ease. This leads to quick assembly, economic installation, and ease of maintenance and system revision. Full lines of molded fittings, such as elbows, tees, traps, reducers, couplings, and others are available for joining with any of the commercially available thermoplastic piping materials by methods such as solvent cementing, threading, heat sealing, and hot air welding.

All of the thermoplastic materials can be cut with either a hand or power hacksaw. Flexible polyethylene can be cut with a sharp knife. As square cuts are desirable, a mitre box should be used when cutting with a hand saw.

How to Bend Plastic Pipe

Bending may sometimes be used advantageously in fabricating plastic piping systems. Bending of rigid thermoplastics can only be accomplished with the pipe heated to make it soft. The pipe must be heated uniformly to temperatures which vary with the material — 210 to 215 F is recommended for ABS I piping, and 250 to 275 F for PVC. Excessive temperature should be avoided and the bend made as quickly as possible so that the pipe is not weakened or deformed.

Pipe to be bent is heated in an oven or by immersion in a hot oil bath. To prevent flattening during bending, the pipe should be filled with sand or other internal support. Bending is best controlled by forming the bend around a regular pipe bending form or a jig prepared for this purpose. The minimum radius to which the pipe should be bent is 5 to 6 pipe diameters. The radius of the bend should be slightly less than the desired radius since there is a small amount of springback. The bend can be air cooled until it becomes rigid and then quickly cooled by immersion in water.

Methods of Joining Pipe

Several methods are used to join plastic piping systems. The method used varies to some extent with the plastic used.

Polyethylene is commonly joined by means of insert fittings and clamps. This method works best with low density polyethylene which is soft and flexible. High density polyethylenes have been successfully joined with insert fittings though more difficulty would be expected in making tight joints this way because of the greater stiffness of the pipe.

A wide variety of insert fittings are available. In order to obtain a good seal these must be hard and they are commonly made of ABS polymer, nylon, and high impact styrene. Where chemicals are being handled, it is important that the chemical resistance of the fittings be at least equal to that of the pipe.

The use of stainless steel hose clamps is generally recommended to minimize corrosion of the clamps. These are especially desirable for buried polyethylene piping systems.

Thread with Standard Machines

Plastic piping can be threaded and this method of joining PVC and ABS was common when they were first introduced. Threaded connections are useful when the pipeline must be disassembled frequently for cleaning or inspection. Because plastics are notch sensitive threaded connections are recommended only for the larger pipe schedules (Schedule 80 and 120). The reduced cross section of threaded Schedule 40 pipe and the stress raising effect of the threads make it subject to impact failure when threaded.

A wide variety of threaded fittings are available for PVC, ABS, and chlorinated polyether pipe. Threaded fittings for PVC and ABS are available in sizes up to and including 4 in. and for chlorinated polyether in sizes through 2 in.

Threads can be cut in pipe by machine or by hand with standard metal thread cutting tools to mate with the standard internal threads of molded fittings and valves. Soap solutions, water, or cutting oils can be used as thread cutting lubricants. Lubricant should be compatible with the material being threaded to avoid stress

cracking. Since plastics are relatively flexible, it is considered good practice to insert a long tapered plug in the pipe end during threading to prevent crushing or rupturing of the pipe wall. During the threading operation the pipe should be protected from chuck or vise jaws by pads of leather and rubber, or by wrapping the pipe with canvas or emery paper.

Use Strap Wrench on Plastic Pipe

When assembling a threaded joint, it should be started carefully and made hand tight. Additional torque can be applied by means of a strap wrench. One turn beyond hand tight is recommended. Further tightening may split the shoulders[13] of the fittings or cause excessive stress in the joint. Standard pipe wrenches should be avoided as they will deform and scar the pipe surface. Standard thread compounds may be used where chemical resistance and product contamination are not a problem. When chemical resistance is required, tetrafluoroethylene resin based compounds or tapes are used. The latter serve both as lubricants and seals. Standard thread compounds may attack some of the plastic materials and manufacturer's recommendations should be followed.

When threaded joints are made between plastic and metal piping, the differences in thermal expansion suggest the use of female plastic components and male metal components to insure leak tightness. Some manufacturers recommend the use of flanged connections or special adapters where the plastics join metal to insure leak free joints.

Solvent Cemented Joints Common

Solvent cemented joints using socket or slip-sleeve fittings are commonly used in PVC, ABS, and CAB piping systems. The other thermoplastics do not lend themselves to solvent cementing. The advantages of solvent cemented joints which have lead to their widespread use are the ease with which joints can be made, and greater assurance of strong and leak free joints. Additionally, since the joint does not weaken the pipe as in the case of threads—strength is derated[8] approximately 50 percent when threaded—a thinner wall section can be utilized for a given working pressure. This has lead to the development of SWP (solvent welded pipe) schedules in which wall thickness is based upon that required to provide the same working pressure for all sizes of pipe in a given schedule. The major drawback of solvent cemented joints is that they cannot be disassembled.

Fit Important in Cemented Joints

When making up a solvent cemented joint it is imperative that the fit of the joint between pipe and fitting be determined before cementing. Experience has indicated[13] that the optimum diametral gap (difference between inside diameter of fitting and outside diameter of pipe) should be about 0.020 to 0.025 in. However, good solvent cemented joints may be obtained with clearances up to 0.040 in. On the other hand, 0.010 in. is considered the maximum interference for a tight fit. When dry fitting shows an excessive gap, the fitting can be set aside and used on pipe that is slightly oversized.

Filled solvent cements provided for use with the various thermoplastics contain dissolved pipe material. These furnish higher body and void filling properties than the earlier unfilled cements. When making the joint, the surfaces to be mated should be cleaned[13] with a suitable solvent (methylethyl ketone, carbon tetrachloride) to assure deposition of a uniform coating of cement. When this has dried, cement is applied quickly to the fitting and pipe. The pipe is then immediately inserted in the socket and given ¼ to ½ turn to further assure uniform distribution of the solvent in the joint and to dispel any entrapped air.

Leave Cement Fillet on PVC Joints

When the filled cements cure, the solvent evaporates and the dissolved piping material remains to fill the voids and assure a good bond. With PVC piping, it is considered good practice to have a good fillet of cement at the entrance of the socket so that the shrinkage of the cement during drying does not cause voids and shrink[14] holes. With ABS and CAB piping the excess

solvent is removed when the joint is made.

Solvent cemented joints gain handling strength in 10 to 15 minutes, but require 24 to 48 hours to acquire full strength depending upon ambient conditions. Once cured, the strength will equal or exceed that of the pipe. While some engineers specify reinforcing with thermal seal back welds, these are not considered necessary. A seal weld applied by thermal welding does offer a means, however, of repairing a leaking solvent cemented joint.

Thermal Welded Joints

Thermal welding of socket joints in PVC, polyethylene, chlorinated polyether, and polypropylene piping systems can be accomplished effectively. However, this method of joining requires greater skill and training of the pipefitter than the other methods. Several organizations are conducting schools to train plastics welders. At present, however, some fabricators may not have experienced plastic welders.

Welding is accomplished by heating the piping and filler rod (it should be of the same material as the pipe) by means of a stream of hot gas. A more recent development for heat sealing of pipe and socket-type fittings employs electric heater elements which are used to simultaneously bring the outside of the pipe and the inside of the socket fitting to the proper temperature for fusion of the mating surfaces. In either case, the temperature is critical and poor joints will result if the temperature is not maintained within narrow limits.

When using the hot gas welding technique, heated air can be used when welding PVC, but for the others an inert gas must be used to prevent oxidation and poor welds. In this regard, when welding polyethylene and polypropylene, oxidation products which occur immediately following extrusion must be scraped away to assure satisfactory results.

Flanged Joints Can Be Used

Flanged joints are often used where lines must frequently be disassembled. Flanges are made to standard dimensions of 125 lb and 150 lb steel patterns to facilitate joining plastic and metallic piping systems by this means. Flanges are formed in small sizes by molding but are fabricated for the large sizes. They are available with both socket and threaded pipe-to-flange connections. Flanged elbows and tees are available for PVC piping.

Gaskets used in flange connections should be chemically resistant and flexible. Neoprene, tetrafluoroethylene, and rubber are commonly used gasket materials. The use of a torque wrench for tightening flange bolts is recommended to assure that the flange is evenly loaded. Because of creep, it may be necessary to periodically check the loading of bolts in flanged joints to assure tight joints.

How They Are Supported

Because plastic pipe does not have the rigidity of metal pipe, it must be supported at more frequent intervals than metallic pipe. The distance between supports depends upon pipe diameter, the operating temperature, wall thickness, and the mechanical properties of the piping material. Recommended hanger spacing for Schedule 40 and Schedule 80 PVC based upon information presented in manufacturer's technical bulletins is given in Figs. 5 and 6. These values are recommended by The Society of Plastics Industry for materials with elastic moduli in the range of 350,000 to 400,000 psi. Thus, they apply to ABS II polymers as well as to PVC. Similar charts are available for other piping materials. The charts are based on uninsulated pipes carrying fluids with specific gravities not exceeding 1.35. If the pipe is insulated, the spans should be decreased by approximately 30 percent.

Conventional Hangers Can Be Used

Hangers should be designed so they do not clamp the pipe thereby restricting axial movement. Hangers which have been used successfully include clevis, strap, roll, ring, and angle types. Broad smooth support surfaces are recommended to avoid excessive stress and abrading of the pipe. Continuous supports should be considered when individual supports are economically pro-

hibitive. Some engineers prefer continuous support whenever the piping will operate close to its maximum permissible operating temperature and they are recommended whenever hazardous fluids are being carried. Angle irons hung with clevis hangers have been used successfully for continuous support. In some cases, investigation may reveal ready made continuous supports in the structure. It should be noted, however, that ambient temperatures must be taken into account and plastic piping should not be laid on steam piping or other high temperature surfaces.

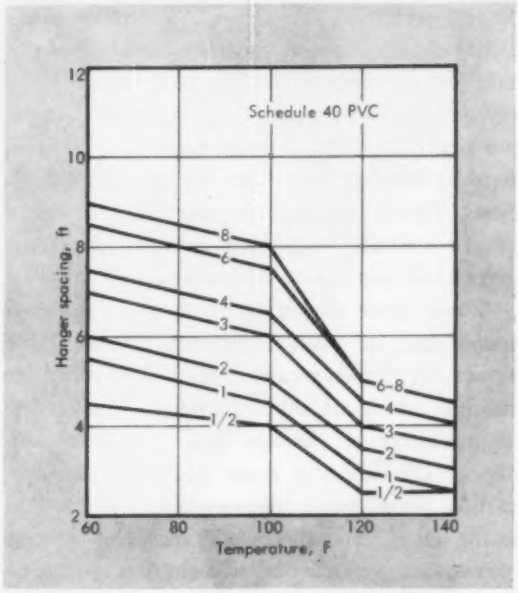
Support Valves Independently

Axial thrust should be controlled by anchoring whenever it may impart undue stress to fittings. This is especially important at 90 deg turns and at branch connections. This is a more important consideration with threaded connections than it is with solvent cemented fittings as the latter are as strong as the pipe and can assume reasonable bending stresses. Metal compression hangers padded with compressible material are satisfactory for this service. Valves should be supported independently and laterally braced so that operating torques do not impose a stress on the pipe line. In long runs of pipe, it has proven desirable[13] to anchor the run at the center to assure that thermal expansion is taken up equally at each end.

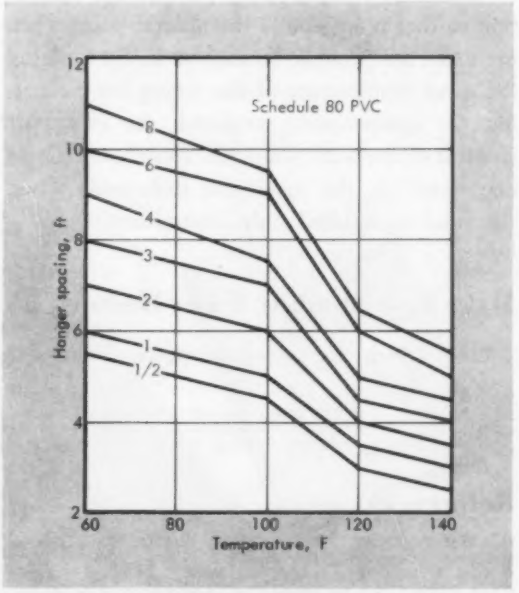
Vertical runs should be spring hung and guided by means of rings or long U-bolts to restrict side movement of the riser to one plane. Where risers are long it may be necessary to support the riser with a saddle at the bottom.

Must Take Care of Expansion

It was noted in an earlier section that the thermal coefficients of expansion of plastics are much larger than those for metal. While in most cases, sufficient flexibility arising from changes in direction exists to take care of expansion, it should be considered in design. If thermal expansion is neglected, failure of the system is likely to result. For example, a PVC I line 100 ft long installed at 75 F will expand approximately 2 in. if its operating temperature is 135 F. Center restraint of the piping, as mentioned earlier, can help distribute the expansion uniformly to both ends of a long run and, therefore, may eliminate the need for expansion joints.



5 HANGER SPACING for schedule 40 PVC piping decreases with operating temperature as shown here. Spacings apply for fluids with specific gravities up to 1.35 and uninsulated pipes. When pipe is insulated, spans should be decreased by 30 percent. Data also applies to ABS II schedule 40 piping



6 HANGER SPACING for schedule 80 PVC piping shown above applies for same conditions as Fig. 5

When expansion cannot be assumed by directional changes several methods are available to take up the expansion. One is to intentionally provide directional changes where the deflections are small. Another is to fabricate an expansion loop by bending or by the use of pipe and elbows. This is the preferred method when space is not critical. Socket-type fittings solvent cemented or heat sealed should be used.

When space is not available for expansion loops, one of several commercially available expansion elements can be used. These include flexible tubing of other materials which meet requirements of chemical resistance and pressures, "O" ring slip joints, rubber and fluorocarbon lined spools, fluorocarbon bellows, and swing joints. The choice will depend upon the service and the amount of deflection that must be absorbed. When using "O"-ring slip joints of the piping material, considerable care must be taken to align the piping to avoid leaks.

Installation at the mean operating temperature will minimize the need for compensation. When this is not possible, the next best step is to adjust the compensating unit during installation so that it will be at the neutral point when the mean temperature is reached. In determining the mean temperature of the piping for estimating the compensation required, the effects of ambient temperature should be considered. These may establish the maximum deflections when the fluid is handled only intermittently.

Make Provision for Water Hammer

Lines which are subject to pressure rise due to sudden changes in velocity must be protected from water hammer. Shock pressures should not exceed twice the recommended working pressure of the pipe but provision should be made to avoid it. Surge chambers made of the piping material[13] have been fabricated from large diameter pipe of the same material as the pipeline to minimize the effects of water hammer.

Underground Installation

When installing thermoplastic piping underground, the primary concern is to prevent damage to the piping during the laying operation. The bottom of the ditch should be smooth and regular to avoid local bending stresses. A fill free of rocks is laid below the pipe. Piping can be assembled in sections above ground and lowered into the trench. Solvent cemented joints or heat sealing for thermoplastics which cannot be cemented are preferred to assure leak free operation. In some cases, a thermally applied seal weld is used to give added assurance of leak free operation. After the piping has been tested, a loose fill like that used on the bottom should be used to cover the piping. The pipe should be approximately at its operating pressure and temperature during the back filling operation, if possible. This minimizes the possibility of deformation of the piping and damage due to expansion.

Underground piping should be laid below the frost line. Compensation for thermal expansion is achieved by snaking the pipe from side to side in the trench. One cycle in each 40 ft or less is considered adequate.

[The editors gratefully acknowledge the assistance of the many plastic pipe, valve, and fitting manufacturers too numerous to mention individually who cooperated in the preparation of this report by providing technical data on the several types of thermoplastic pipe discussed herein.]

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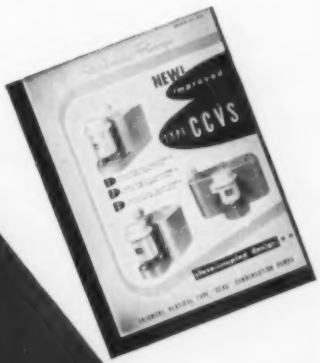

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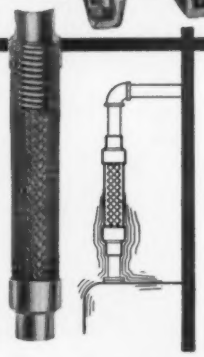

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3745 Ninth Street, Long Island City 1, N.Y. • N.Y.C. Phone: 212-St 4-5173

EQUIPMENT DEVELOPMENTS
Continued

Strainers Feature Heavy Design

"Y" strainers suitable for all steam, water, air, oil, or gas applications to protect traps, regulators, meters, etc. from dirt, scale, pipe cuttings, and other foreign material. Available in ¼ through 3 in. in semi-steel; ⅜ through 2 in. in ductile iron or cast steel; 1½ through 2 in. in bronze or stainless steel. Also, block steel angle strainer for service to 1500 psig at 850 F, cold pressures to 3500 psi w.o.g. in carbon steel. Connecting pipe sizes ½ to 3 in. Bulletin 171 sent on request. — *McAlear Manufacturing Co., 1901 S. Western Ave., Chicago 8.*

Duct Sealant Adhesive For Permanent Service

"Permacel EZ-4719" for permanently sealing all types of sheet metal flanges and seams in high velocity heating and air conditioning systems and to seal off screw and rivet head attachments. Oil and water resistant adhesive bonds to both galvanized and aluminum sheet metal ducting. Once cured, will flex with expansion and contraction. — *Permacel, New Brunswick, N.J.*

A-C Welders Feature Movable Coil Design

"S" series has 300 and 500 amp units with movable coil design. Features silicon steel cores, 80 v open circuit, Class B insulated copper coils, and dead front construction. — *Miller Electric Mfg. Co., Appleton, Wis.*

EQUIPMENT DEVELOPMENTS
Continued

Hot Water Converters In 114 Models, 2, 4-Pass Design

"NiaWel" units for space heating service available for steam inlet pressures of 0, 2, 5, 10, or 15 psi and temperature ranges of 160 to 180, 180 to 200, 190 to 210, or 200 to 220 F. Standard shells, flanges, nozzles, drains, tube supports, and cradles of welded, flange steel construction. Bulletin 71 sent on request. *Niagara Weldments Inc., 55 Portage Rd., Niagara Falls, N.Y.*

Butterfly and Ball Valves In Various Sizes, Types

Butterfly valves available in sizes from 2 to 18 in. rated at 150 psi water gage. Cast iron bodies nickel-plated, with stainless steel trim and rubber linings. Adapter flanges for elements available for screwed, welded, flanged, or grooved installations. Ball valves available in bronze body, screwed ends, sizes ¼ to 2 in., with "Teflon" or Buna-N seats and seals. — *Lunkenheimer Co., P.O. Box 360, Annex Station, Cincinnati 14.*

Infrared Lamps for High Temperature Service

"T3" infrared quartz heat lamps contain a red filter to eliminate over 99 percent of produced light. Firm's quartz line will comprise 12 types of lamps ranging from 375 to 3800 w, in lengths from 5 to 41 in., in addition to the red lamps. Normal life expectancy of lamps in excess of 5000 hr. — *Westinghouse Electric Corp., Lamp Div., Bloomfield, N.Y.*

Allflex

FLEXIBLE METAL HOSE & TUBING

HEAT RESISTANCE + PRESSURE RESISTANCE + CORROSION RESISTANCE + FLEXIBILITY

- Absorb expansion
- Isolate vibration
- Correct misalignment
- Compensate offset motion
- Continuous flexing
- Reciprocating motion
- Loading hose, and all extreme bending and flexing applications.

ALLIED'S wide range of IN-STOCK standard flexible metal hose connectors will solve your pipeline-motion problems FAST.

ALLFLEX
"MNH" FLEXIBLE METAL HOSE CONNECTORS

STAINLESS STEEL • BRONZE • MONEL
SAME DAY SHIPMENT on ALL THESE STOCK SIZES:
¼" ⅜" ½" ¾" 1" 1¼" 1½" 2" 2½" 3" 4"
EACH IN ALL THESE STOCK LENGTHS:
12" 18" 24" 30" 36" 48" 60" 6 ft. 8 ft. 10 ft. 12 ft. 15 ft.

"TOMORROW" shipment of any length, with any end fitting connection. S/S to 16", Bronze to 8", Monel to 4".

ALLFLEX
DIESEL HOSE
- STAINLESS STEEL
- CARBON STEEL

Tames Vibration and Compensates for expansion on EXHAUST and AIR INTAKE LINES
SIZES: Thru 16"
CONFORM TO GOVT. SPEC. MIL-H-19034

ALLFLEX
EXPANSION COMPENSATORS

Absorb pipeline expansion • Installed at right angles to direction of movement • Custom engineered to solve your specific problem • For pipelines thru 16" size • Temperatures to 1200°F.

All Allflex products available with all standard or special couplings and flanged end connections. Write, wire, phone today for your ALLFLEX DATALOG and name and address of your nearest ALLIED FLEXOLOGIST.

Heating, Airconditioning & Piping Division

ALLIED METAL HOSE CO.

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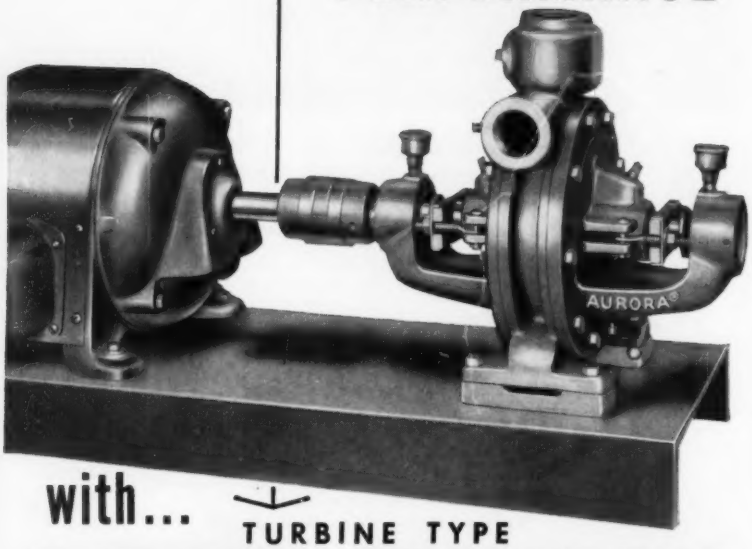
Profit by... CONTROLLED PERFORMANCE



with... TURBINE TYPE

APCO PUMPS

- PROVEN DEPENDABILITY
- CALCULATED CAPACITIES
- RUGGED CONSTRUCTION
- HIGHEST QUALITY CONTROL
- APPLICATION ANALYSIS
- SELECTED COMPONENTS
- MINIMIZED WEAR
- SERVICE FLEXIBILITY
- PRESSURES TO 400 P.S.I.
- CAPACITIES TO 150 G.P.M.

Ruggedness of construction and simplicity of design of APCO turbine type pumps combine to provide longer life, high efficiency, and minimized down time. This means more for your "pump operating dollar." With APCO *steep impeller* characteristics there is little capacity change under fluctuating head conditions. Select from the "1001" types, sizes, and capacities of AURORA pumps to obtain *the one* specifically designed to fit your needs.

APCO turbine type pumps are most frequently used for: Boiler Feed, Condensate Return, Fresh Water Service, Brine Service, Ice Water Circulation, Filter Service, LPG Service, Transfer Service, Caustic Liquid Handling, Sprinkler Service, Spraying Service, Water Treatment, Booster Service, and High Temperature Service.

WRITE TODAY FOR NEW BULLETIN S-111

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
650 LOUCKS STREET • AURORA • ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

EQUIPMENT DEVELOPMENTS

Continued

Welding Caps for Fabricating Pressure Vessels

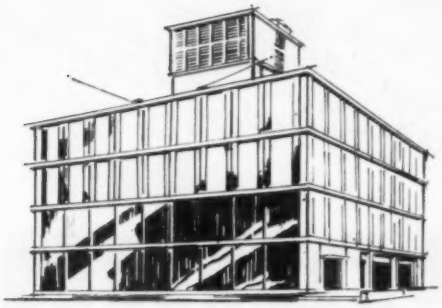
Stainless steel and aluminum welding caps for use in fabricating vessels for pressure application. Ellipsoidal in shape with straight tangent, units require only butt-welding to straight cut pipe to conform to ASM specifications. Pressure rating corresponds to that of pipe schedule. Units available in Schedules 5S, 10S, 40S, 80S, and double X heavy. Bulletin 416 sent on request. — *Flowline Corp., New Castle, Pa.*

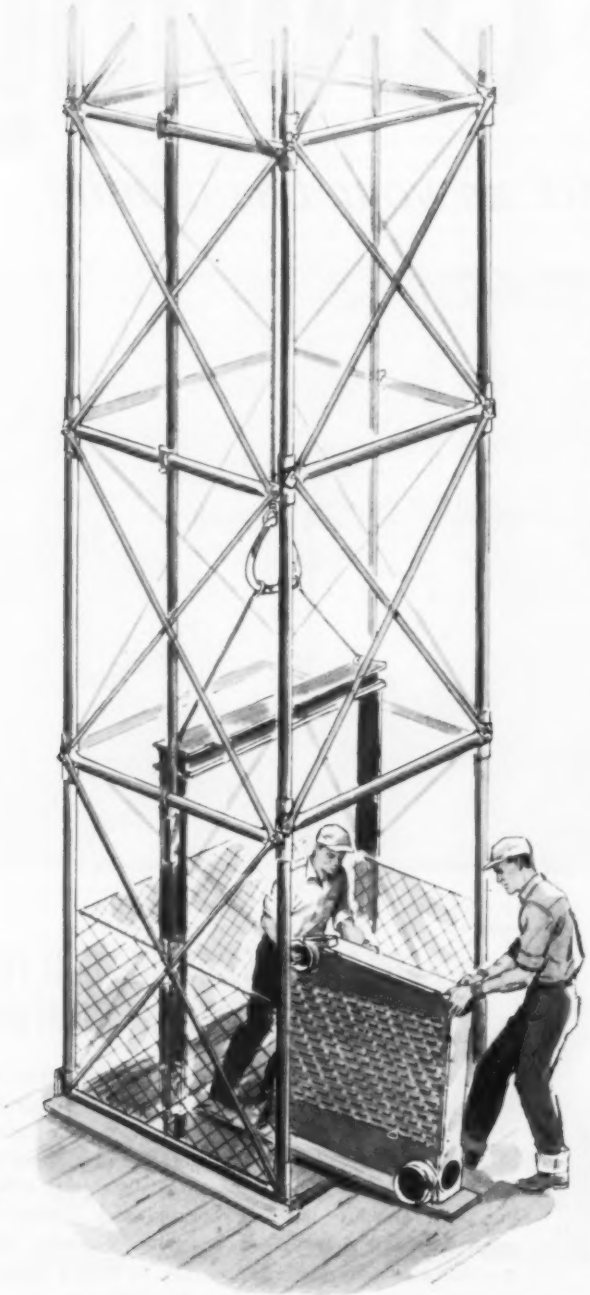
Lagging Adhesive Withstands Temperatures Over 200 F

Adhesive water based, non-inflammable, non-toxic, vermin-proof, with a low freezing point. Produces a water-proof and steam resistant dried film. Can be applied by brush, dip, or spray methods. Literature sent on request. — *St. Clair Rubber Co.*, 107 *Clifford, Detroit* 26.

Recording, Indicating Controllers Completely Self-Contained

Round chart recording and indicating controllers, self contained, require external sensing device only. Null-balancing instruments for the measurement, indication, control, and permanent recording of temperatures. Bold-figured 32 in. scale is stationary; set point and control point move. Units give 0.5 percent accuracy for all scale spans in pyrometric range. Zener Diode assures continuous standardization. — *Barber-Colman Co.*, 1701 *Rock St., Rockford, Ill.*





HOW TO INSTALL A BOILER IN A PENTHOUSE... *WITHOUT A DERRICK!*

It's no trick at all with a Weil-McLain cast iron sectional boiler—either gas or oil fired. In penthouse installations, the sections can be brought up in the personnel hoist...no need to rig a derrick.

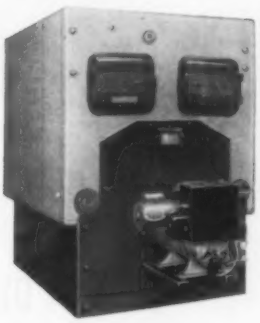
Both in new construction and in replacement work, the sectional construction of Weil-McLain Boilers is a distinct and valuable feature. The work on a new building need not be held up waiting for the arrival of the boiler...nor must the boiler be installed before the building is completed, subjecting it to weather, construction damage or vandalism.

If a boiler is to be completely replaced, a Weil-McLain cast iron boiler can be moved in through an ordinary door, section by section. If additional capacity is required, a second boiler can be installed to supplement the original boiler. Or, additional sections can be added to the present boiler. Weil-McLain Boilers are assembled with short draw rods, a feature which simplifies erection and assures freedom from stresses and strains.

For detailed information on Weil-McLain Oil Boilers, see Engineers' Product File or Sweet's Architectural File. For current Gas Boiler data, send for Bulletin C-297.

WEIL-McLAIN BOILERS FOR COMMERCIAL AND INDUSTRIAL HEATING SYSTEMS

FOR GAS
Capacities to
3,354,000 BTU/hr.



FOR OIL
Capacities to
2,942,500 BTU/hr.

WEIL-McLAIN
CAST IRON BOILERS

Address literature requests to Dept. AA-31

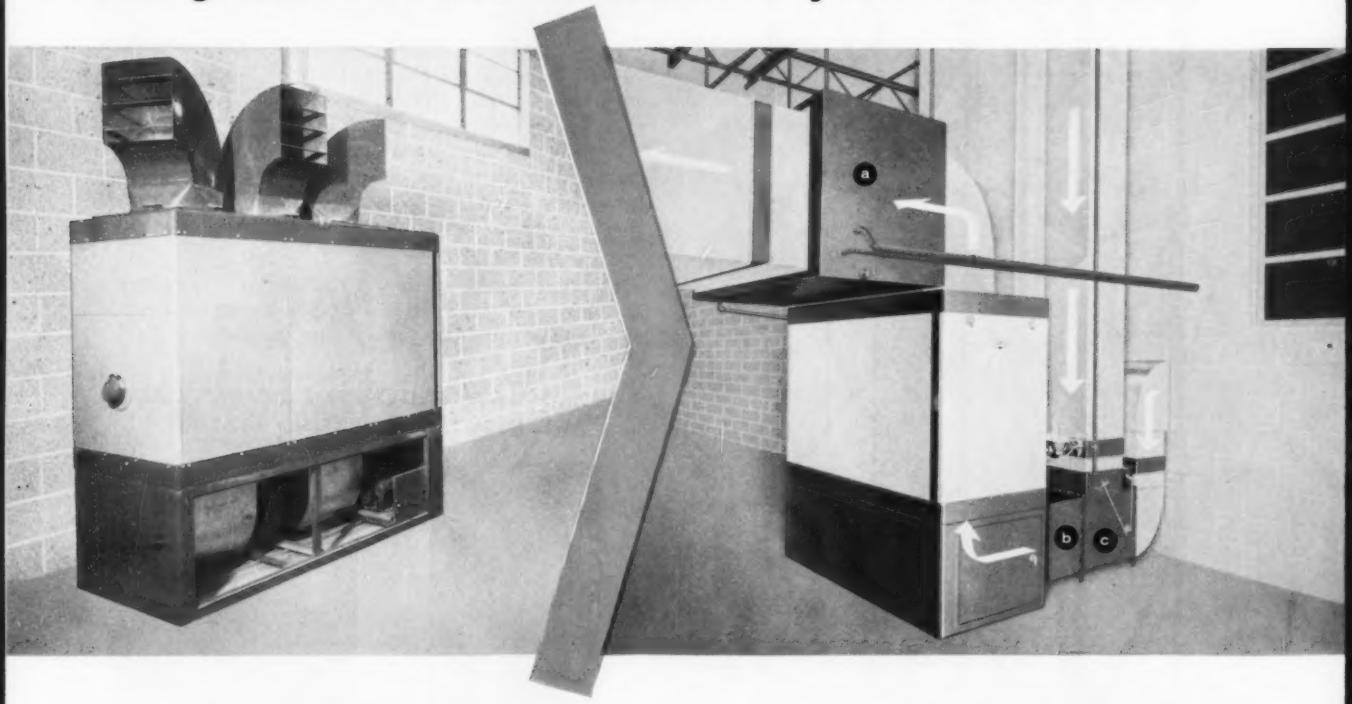
WEIL-McLAIN COMPANY, INC. • DEPT. AA-31 • MICHIGAN CITY, INDIANA

New from **LENNOX**

Mr-
This is great.
We installed these recently.
Management still amazed
at production increase.
J. W.

factory cooling

...using direct-fired heaters as your basic units



1. LENNOX DIRECT-FIRED SPACE HEATER—THE BASIC UNIT

Here's the unit you start with—the highly efficient Lennox OG4 industrial heater (gas, oil or combination). Absolute simplicity of design allows this stainless and aluminized steel unit to be applied in an upright, inverted or horizontal position. It can be installed for heating and ventilating needs now, with cooling easily added at a later date. Or, if you prefer, include the cooling coil in the initial installation.

2. ADD LENNOX COOLING COIL FOR YEAR 'ROUND PLANT COMFORT

Here you see how the cooling section (a), filter section (b) and mixing damper for outdoor air and return air (c), combine with the OG4 heater to provide year 'round cooling, heating and ventilating. The mixing damper can be controlled manually or automatically. Never before has an all-purpose line incorporated such versatility, ease of installation and maintenance, together with extreme efficiency and adaptability to widely varying heating, cooling and ventilating requirements.

For further information and a Lennox cooling survey (at no obligation), write LENNOX, 618 S. 12th Ave., Marshalltown, Iowa.

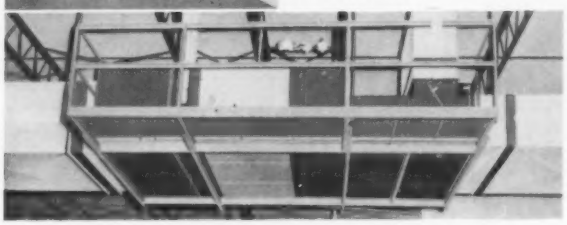
...increases factory production up to 28%

Air conditioning is justified if it only increases production 1½% to 3%

The benefits gained from factory cooling can, in most cases, make it a necessity. No one would expect employees to work in a cold building during the winter, so how can they be expected to work at full capacity in a hot one during summer? Once the advantages are weighed, factory cooling usually gains an overwhelming vote of approval from management. And, once *you* compare Lennox equipment with any other line, you'll see the reasons for the big switch to Lennox in industrial heating, cooling and ventilating.

MANY WAYS TO APPLY

Combined here are a Lennox down-flo OG4 central furnace, a cooling section, a filter section and a mixing damper for return and fresh air. The unit feeds a distribution perimeter loop buried in the concrete floor.



In this factory the OG4 has been combined with an evaporator section, filter section and damper for return and fresh air. It is suspended and has a service platform. This package closely controls temperature, humidity and make-up air all year.

Don't be satisfied with less than

LENNOX

HEATS • COOLS • TREATS AND MOVES AIR

IN HOMES IN CHURCHES IN SCHOOLS IN BUSINESS IN INDUSTRY

LENNOX INDUSTRIES INC., FOUNDED 1895 — MARSHALLTOWN AND DES MOINES, IOWA; COLUMBUS, OHIO; SYRACUSE, NEW YORK; DECATUR, GEORGIA; FT. WORTH, TEXAS; SALT LAKE CITY, UTAH; LOS ANGELES, CALIFORNIA. LENNOX INDUSTRIES (CANADA) LTD. — TORONTO, MONTREAL, CALGARY, VANCOUVER, WINNIPEG.

EQUIPMENT DEVELOPMENTS

Continued

Deaerator Eliminates Entrained Air, Serves as an Expansion Tank

Tank installed in main on supply side of boiler with all heated boiler water passing through it on way to heating units. Entrained air and boiler vapors released by system of strategically placed baffles and trapped in tank. By feeding make-up water into tank, entrained air immediately trapped. Tank serves as only air-eliminating device required on series-loop baseboard systems, as well as an expansion tank and tempering device on circulator start. — *General Automatic Products Corp., 2300 Sinclair Lane, Baltimore 13.*

Bimetal Disc Thermostat Has 8 Deg Maximum Differential

Units have range of calibration between 125 to 180 F. Calibration factory preset and non-adjustable. Type "11T," SPST or SPDT, listed at 25 amp resistive, or 1 hp inductive, at 120/240 v a-c. Surface airstream or water-tight mountings. Enclosed or exposed bimetal discs. Terminals available include inclined blade, vertical blade, and screw terminals. — *Therm-O-Disc, Inc., Mansfield, O.*

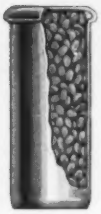
Double Scroll Centrifugal Fans Equipped with Double-End Motors

Units have air deliveries ranging from 200 to 400 cfm at moderate pressures. Special mounting brackets and filter cabinets available for adapting units to existing cabinet designs. — *Propellair Div., Robbins & Myers, Inc., Springfield, O.*

Metal Chimney May Be Used for Equipment Burning All Fuels

Unit consists of three concentric metal walls, with air separation. Has a 7 in. inner flue of stainless steel. Suitable for equipment burning solid, liquid, or gas fuel. Three painted metal housings available. — *Dura-Vent Corp., 2525 El Camino Real, Redwood City, Calif.*

Here's why any powder-actuated tool works better with Remington Loads and Studs



← Exclusive "Kleanbore" Priming

22 caliber Power Load (twice actual size)

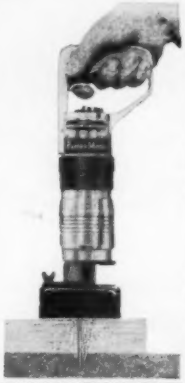
Scientifically graded Remington Power Loads offer precise, uniform charges . . . have strong, non-rusting brass cases. Exclusive "Kleanbore" priming mixture protects bore of tool because it does not cause rust or corrosion. No need to clean barrel after every job! These quality Power Loads are subjected to multiple inspection during manufacture, are backed by Remington—a name well known to American sportsmen. No matter what powder-actuated tool you use, it will work *better* with Remington Power Loads!

← Green "Power-Guide"

¼" S-25 Stud (twice actual size)

Uniform performance and penetration are assured with precision-made ¼" and ⅜" diameter Remington Studs. These high-strength studs are made with special molybdenum steel. Specify Remington Studs with exclusive green "Power-Guide" heads . . . for uniform performance and straight-driving penetration. Over 60 "job-rated" Studs to choose from—your assurance of a Remington "Power-Guide" Stud to fit every fastening application.

Remington know-how insures the quality of its Studs and Power Loads. No other company can offer the background of experience gained through the manufacture of billions of these units. When you order studs and loads, you'll get better performance if you specify Remington—maker of the most versatile fastening tool ever designed (right). We'll gladly send valuable free booklets about Remington Power Loads, Studs and fastening tools. Mail the coupon today!



Remington Model 455A Stud Driver

Remington

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REG. U.S. PAT. OFF.

Remington Arms Company, Inc., Bridgeport 2, Conn.
IN CANADA: Remington Arms of Canada Limited, 36 Queen Elizabeth Blvd., Toronto 18, Ont.

HPA31

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*Company*_____

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*City*_____ *Zone*__ *State*_____

EQUIPMENT DEVELOPMENTS

Continued

Two-Way Radio for On-The-Job Communication

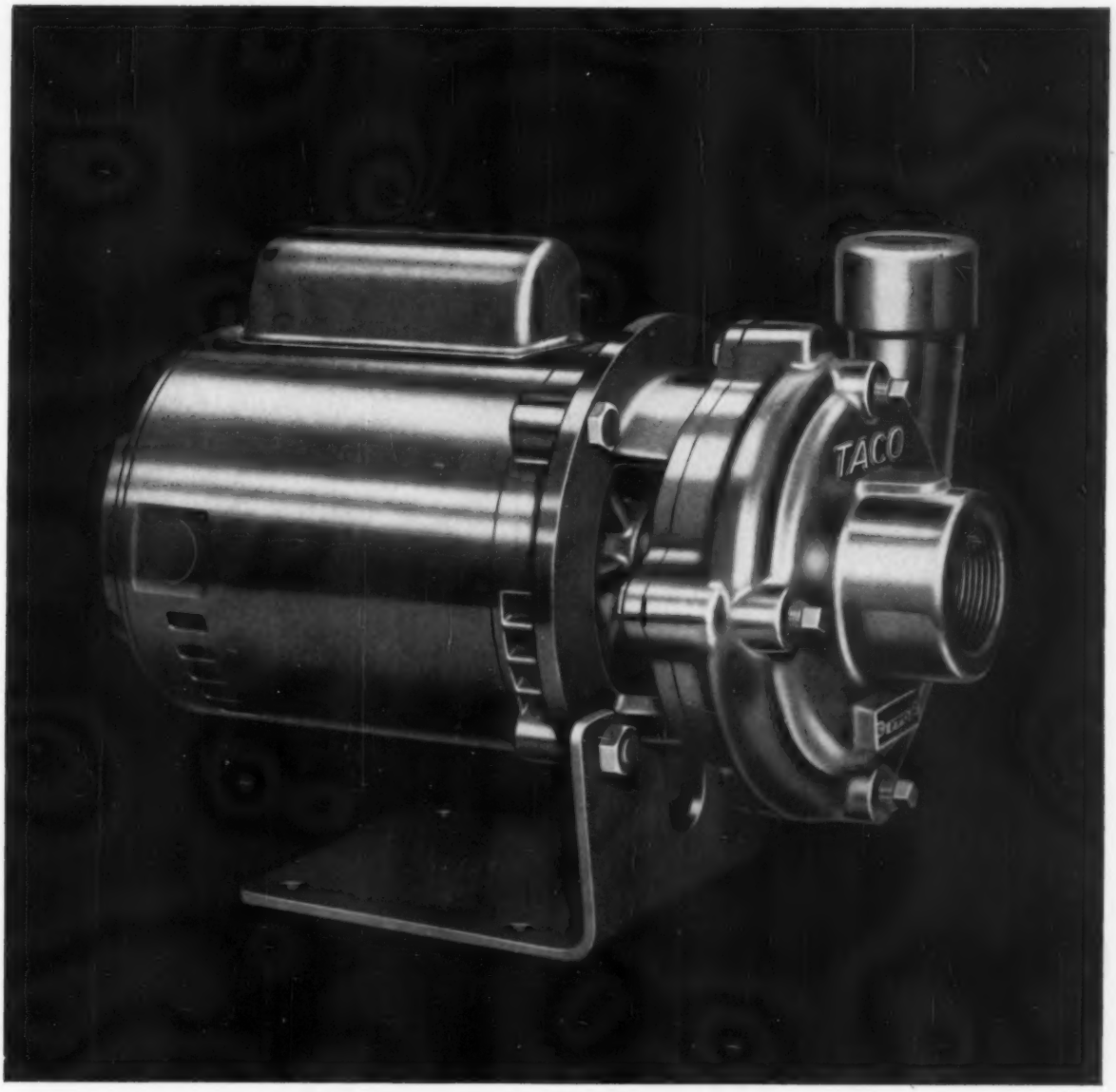
Nine transitor citizens' band unit operates on any of 23 channels. Features a four channel selector with plug in crystals. All metal die-cast case 1⅞ × 6 × 7 in. Squelch control, noise limiter, and push-to-talk microphone with a 3 ft cord included. Unit operates on 115 a-c with converter available for 6, 12, 24, or 32 v d-c operation. Operating power no more than car dome light. — *Osborne Electronic Sales Corp.*, 131 *S. Crenshaw Blvd., Hawthorne, Calif.*

Vibration Isolation Pad Made Of High Density Glass Fibers

Kinetic pads isolate vibration and eliminate lagging equipment to floor. Furnished in 18 × 18 × ½ in. sheets, pre-scored at 2 in. intervals for easier job-site cutting. Product will not creep. — *Consolidated Kinetics Corp.*, 1065 *Dublin Road, Columbus* 12, *O.*

Ball Valves Offered in Combinations of Metals

Ball valves with Navy G bronze or semi-steel cast bodies; or brass, steel, and 303 or 316 stainless steel bar stock bodies. Offered with "Teflon" seats and seals, with other materials to be available. Sizes range from ¼ to 2½ in. for pressures up to 400 psi water, oil, or gas, and temperatures to 450 F. Reference Book 39, Section 5 sent on request. — *Homestead Valve Manufacturing Co., Coraopolis, Pa.*



Lubricate in 1970

That's right. If you put the TACO General Purpose Pump into operation today, you can forget about lubricating it until 1970! Actually the motor is permanently lubricated, but we recommend re-packing the bearings every ten years. No other parts of this rugged pump *require* lubrication! Freedom from lubrication worries is just one of many reasons why the TACO General Purpose Pump is ideal for use in air conditioning systems, commercial installations, laundry equipment, swimming pools, and hundreds of other applications. Design has been so simplified that any servicing necessary can be done in the field, with tools ordinarily carried by all service men. Compact and lightweight, the TACO General Purpose Pump saves installation time too. And its dependable performance saves costly "call backs" In short, it provides a better all around return for your investment. Get complete specifications now. All products in the *complete* TACO Line are "efficiency engineered" to provide maximum performance and economy in all your installations. Write TACO HEATERS, INCORPORATED, 1160 Cranston Street, Cranston 9, Rhode Island.

TACO

SERVING THE HYDRONIC INDUSTRY SINCE 1920

Yes, Dart Unions fit tighter and last longer because their two bronze seats are precision ground to a true ball joint. You get a drop-tight connection without straining arm, wrench or union. What's more, a Dart uncouples just as easily. Ask your supplier.

QUICK FACTS

- Extra wide bronze seats resist pitting and corrosion.
- Nut and body of air-refined, high test malleable iron are practically unbreakable
- Heavy shoulders can withstand the toughest wrench abuse
- Each Dart is individually vacuum-tested

DART UNIONS *Products of* DART UNION COMPANY PROVIDENCE 5, R.I.

GENERAL SALES AGENT

THE Fairbanks COMPANY
393 LAFAYETTE STREET, NEW YORK 3, NEW YORK
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AVAILABLE THROUGH YOUR LOCAL DISTRIBUTOR

EQUIPMENT DEVELOPMENTS
Continued

Leak-Proof, Canned Pumps With Automatic Thrust Balance

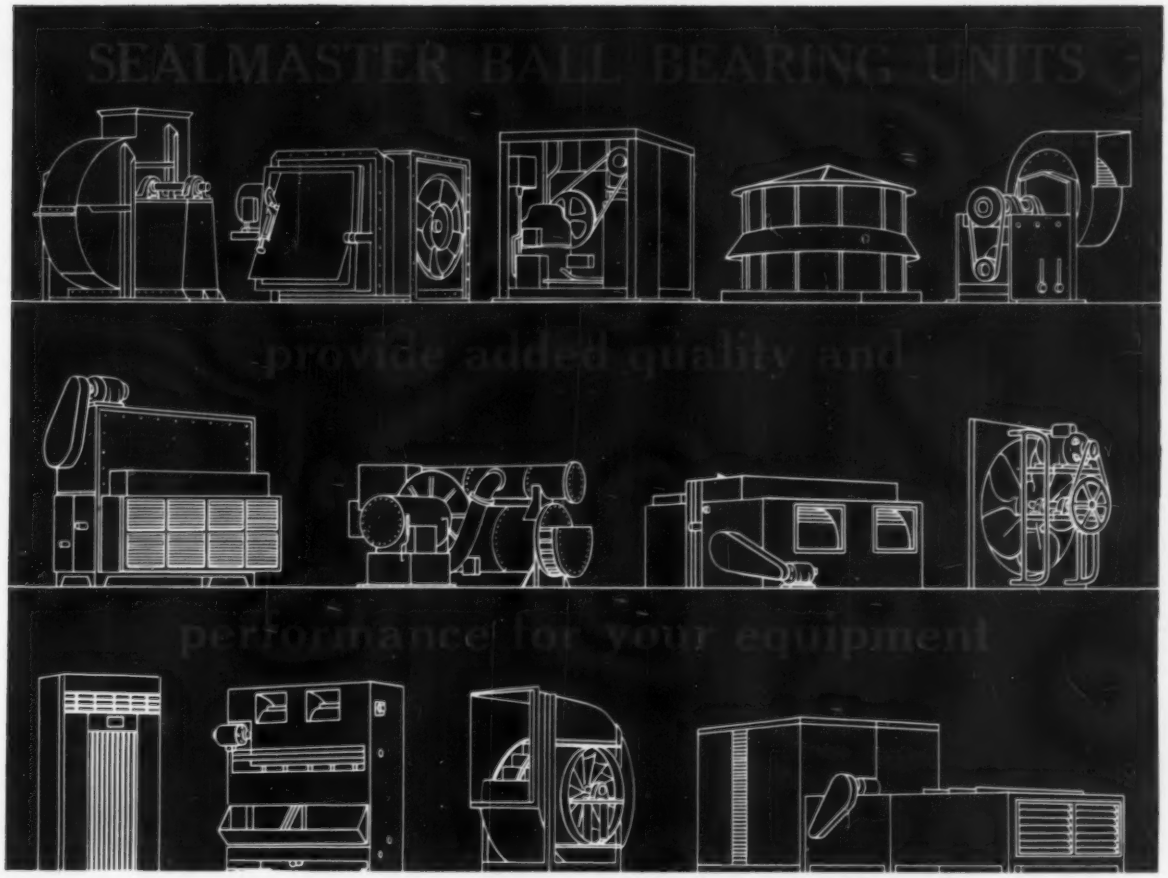
Leak-proof, canned units "Series G" combine automatic thrust balance design with larger bearings and bearing surfaces for increased longevity. Motor life extended by an oil filled stator cavity that dissipates heat from motor windings. — *Chempump Div., Fostoria Corp., Huntingdon Valley, Pa.*

Year Around Air Conditioner For Under Window Installation

Units combine a convector radiator and a through-the-wall air conditioner in one cabinet. Seventeen chassis, with cooling capacities from 6000 to 13,500 Btu per hr operation on all types of current. Heating element has aluminum fins with die-formed collars bonded to internally expanded ½ in. copper tubing. Units fit under standard windows and project 8 in. into room. Convector cabinet and radiator can be installed alone, with future provision for air conditioning installation. — *Fedders Corp., 58-01 Grand Ave., Maspeth 78, N.Y.*

8-Gage Portable Nibbler Develops Two-Ton Pressure

Unit operates on a punch-and-die principle, operating at 1000 strokes per min, no load; 600 spm at rated load. Cuts mild steel up to 8-gage on a production basis; stainless and monel of lighter gages; copper up to 3/61 in. Unit weighs 16¼ lb. — *Black & Decker, Towson 4, Md.*

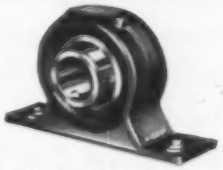


SEALMASTER Ball Bearing Units give a decided quality advantage at no premium in price. Exclusive SEALMASTER engineering features are designed to provide years of efficient performance. SEALMASTER'S diversified lines of bearing units enables you to meet all types of bearing applications and specific mounting arrangements. Whatever your bearing requirements may be, with regard to quality, performance, load or economy, you'll find SEALMASTER has it. For full information on SEALMASTER Ball Bearing Units, including the new low cost "L" Series Units and "L" Series Units with contact seals, call your SEALMASTER factory sales representative or distributor, or write direct to the factory.

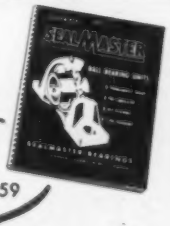
Normal-Standard-Medium Duty
PILLOW BLOCKS

Standard-Medium Duty
FLANGE UNITS

RUBBER MOUNTED
CARTRIDGE UNIT



RUBBER MOUNTED
PILLOW BLOCK



WRITE FOR
CATALOG 454
and BULLETIN 359

LF FLANGE UNIT

SEALMASTER

BALL BEARING UNITS

SEALMASTER BEARINGS A division of
STEPHENS-ADAMSON MFG. CO.
47 Ridgeway Ave. • Aurora, Illinois

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI • BELLEVILLE, ONTARIO

LIGHTEST,

most powerful

4" segment bender

on the market

Greenlee No.777

(1-1/4" thru 4")

weighs only 65 lbs.

(exclusive of shoes)

Save time, cut costs on piping installations with the new Greenlee No. 777 that does more jobs for you than any other bender of its type. Use it to make large sweeps, concentric bends, offsets, 90° bends right on the job. 27-ton ram has power to spare for bending steel or aluminum pipe 1¼" thru 4". A few optional parts adapt it to fast, one-shot 90° bending ½" thru 2". Easy one-man operation with hand or power pump. For more information write for Bulletin E-249.

The Greenlee line of timesaving hydraulic pipe benders also includes No. 880-M2 for ⅛" thru 2" . . . No. 883 for ½" thru 3" . . . No. 884 for ⅛" thru 4" . . . and No. 785 BE for 1¼" thru 6". All make 90° bends in one shot.

GREENLEE TOOL CO., 1952 Columbia Ave., Rockford, Ill.

GREENLEE JOB-PROFIT TOOLING

. . . cost control for contractors

EQUIPMENT DEVELOPMENTS

Continued

17 Ton Evaporator Has Twin Blowers

Evaporator coil and filter section remain fixed in a horizontal arrangement; variations in blower location and direction of air flow provide for upflow, downflow, or horizontal air delivery. Coil constructed of ripple-edged aluminum fins flat-bonded to seamless copper tubes. Blower section consists of twin 15 in. blowers on a single shaft, powered by motor and drive selected for desired cfm and static requirements. Filter section connects to either blower or coil section air intake. — *Lennox Industries Inc., Marshalltown, Ia.*

Load Bearing Insulation For Underground Pipe Service

Insulation for use at pipe hanger locations, deeply buried underground lines, and other areas where pipe covering may be subject to compression deformation. "Rigid Armaflex" with built-in vapor barrier for use on dual temperature lines up to 220 F. — *Armstrong Cork Co., West Liberty St., Lancaster, Pa.*

Electric Pressure Switches For Air Compressors

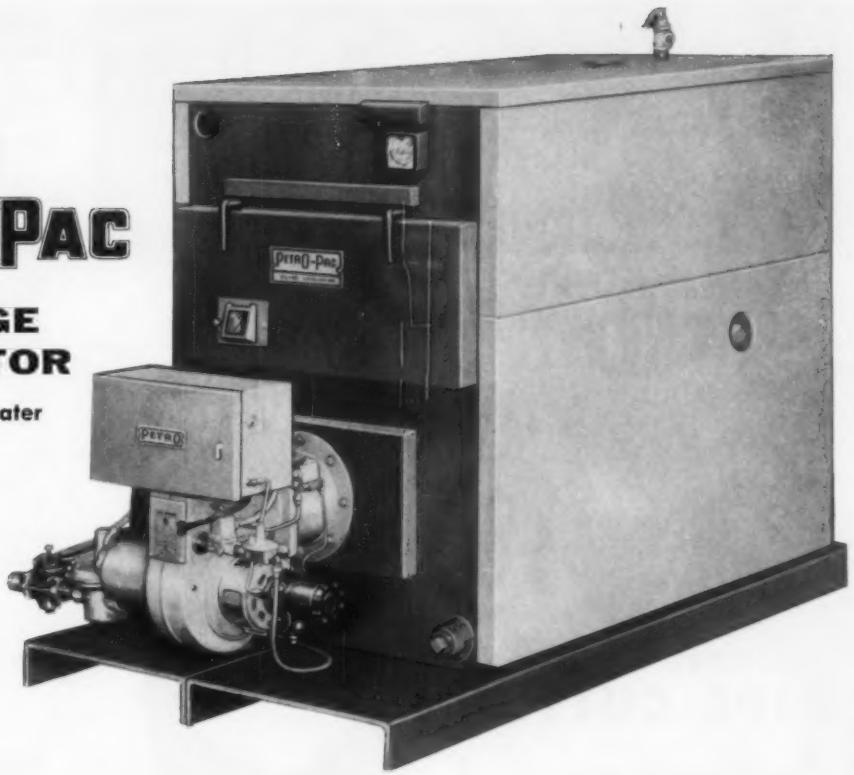
Units rated 1½ hp, 150 psi maximum. Available in large or small enclosures, features pressure wire connectors, visable fine silver contacts, no-drift pressure settings, snap action, optional pulsation orifice, and optional hand disconnect. Bulletin 69B2 sent on request. — *Furnas Electric Co., 1041 McKee St., Batavia, Ill.*

NEW

PETRO PAC

PACKAGE GENERATOR

steam or hot water



WHEN YOU SELECT A NEW HEATING PLANT

are these your problems?

Your building does not have a stack or chimney, or the draft conditions are poor Forced draft firing makes natural draft chimney or stack unnecessary. With PetroPac only an exhaust vent is necessary.

You must keep maintenance to a minimum Troublesome maintenance of buckling, spalling refractory sidewalls is eliminated. New design burner head does not require heat reflecting refractory to support combustion.

You want to avoid divided responsibility among different manufacturers and contractors PetroPac is a complete package. No separate contracts.

The unit you select must stop standby loss PetroPac sealed combustion, forced draft design stops cold air from circulating through combustion chamber; eliminates heat wasting refractory sidewalls—standby loss is negligible.

You must reduce on-site assembly labor costs PetroPac package is factory assembled and tested, ready for service connections.

Your boiler room ceiling is low Old style boiler base is eliminated. PetroPac reduces the height of the base from as much as 3 feet to 3 inches.

Mail coupon for complete literature and specifications on the new PetroPac package generator

PETRO

T. M. REG. U. S. PAT. OFF.

Makers of quality heating and power equipment since 1903

Petro, 3314 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto)

Please send me literature and specifications on dependable PETRO steam and hot water generators.

Name_____

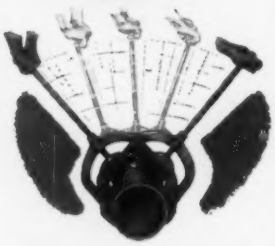
Firm_____

Address_____

City_____ State or Prov._____

Cut Steel or Cast Iron Pipe up to 12" EASIER and FASTER

WITH THE NEW REED



HINGED 4-WHEEL
PIPE CUTTER

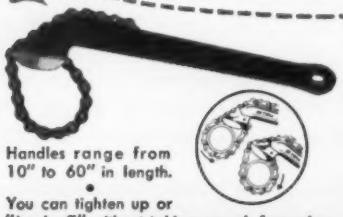
- Closed Frame Construction assures complete rigidity with less weight.
- 4-Wheel design needs minimum swing of handle.
- 4-Point pipe guide aligns cutter for perfect tracking of wheels and a right angle cut.
- Quickly interchangeable wheels for steel or cast iron.
- Needs only 3" space to pass under 12" pipe.

For ditch work or similar close-quarter operations these new Reed Cutters are practically indispensable and fully justify replacing whatever cutting equipment you are now using.

You can, for example, cut 8" steel pipe in less than five minutes, and cast iron pipe even faster.

Available in five sizes for steel or cast iron pipe from 1" to 12".

FOR FAST TURNING IN TIGHT SPOTS—
USE THE IMPROVED REED CHAIN WRENCH



Handles range from 10" to 60" in length.

You can tighten up or "back off" without taking wrench from pipe.

These improved chain wrenches will do anything an ordinary pipe wrench will do... and do it easier, better and faster. Ideal for ditches or tight corners.

Grip securely with no play, yet they have a ratchet-like action.

REED

Unconditionally guaranteed to be the most efficient tools you have ever used. See your jobber or write for literature.

REED MANUFACTURING COMPANY
ERIE • PENNSYLVANIA

EQUIPMENT DEVELOPMENTS
Continued

Hermetic Compressors Have 5, 7½ Hp Capacities

Short stroke, large bore machines with aluminum connecting rods and pistons. Five hp model has three cylinders; 7½ hp, four. Crankshaft and rotor statically and dynamically balanced as an assembly. Features anti-slugging valve; internal vibration isolators; built-in suction and discharge line; and a sight glass for checking oil pump operation. Firm anticipates use of units in its packaged equipment requiring such capacities. — *The Trane Co., La Crosse, Wis.*

Gas Burners Feature Interchangeable Components

Automatic motorized, mechanical-draft inshot type gas burners feature a selection of six burner sizes in 15 burner assembly variations, providing capacities to 35,000,000 Btu per hr. Standard interchangeable parts include: four valve-manifold assemblies, seven control cabinet arrangements, and three optional oil assemblies for stand-by fuel firing. — *Mettler Co., Inc., Div. of Eclipse Fuel Engineering Co.,* 1101 *Buchanan St., Rockford, Ill.*

Tubeforming Machine For 3 to 36 In. Duct

"Spiro 403B" makes duct in gages from 0.015 to 0.037 in. and diameters from 3 to 36 in. Fully automatic, requires only one operator. Two widths of strip employed for all dimensions of duct. — *Spiro U.S.A., Inc.,* 20 *N. Wacker Dr., Chicago* 6.

Now it's much easier to solve your pipe motion problems

. . . with new Flexonics EXPANSION JOINT *ENGINEERING GUIDE*

EXPANSION JOINTS

EXPANSION COMPENSATORS

PIPE ALIGNMENT GUIDES

FLEXIBLE CONNECTORS

New convenient way to solve pipe motion problems! Flexonics Expansion Joint Engineering Guide – just off the press – contains a wealth of vital information in easy-to-read, easy-to-use form. 42 pages of calculations, tables, anchoring and guiding data. Every piping system designer needs this new book. Mail the coupon for your FREE copy!

EJ-275

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METAL and SYNTHETIC HOSE
EXPANSION JOINTS
BELLOWS • SPECIAL TUBULAR ASSEMBLIES

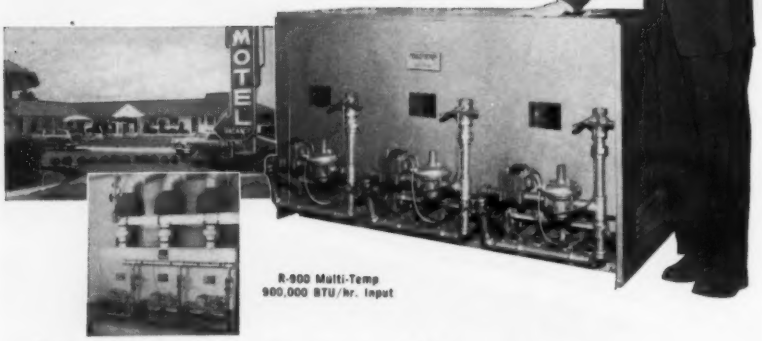
SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

Flexonics Corporation
290 E. Devon Avenue
Bartlett, Illinois

Please send my free copy of the new Flexonics Engineering Guide on Expansion Joints, Expansion Compensators, and Pipe Guides and Supports.

when the heat's on



R-900 Multi-Temp
900,000 BTU/hr. Input

be sure it's

When the job's got to be right . . . at the right price . . . remember Hydrotherm!

Gas heat costs less than oil heat in big jobs (to 3,600,000 BTU/Hr) when you install Hydrotherm's MULTI TEMP hydronic system.

Sequence-fired combustion chambers permit automatic input modulation in accordance with load requirements — no short cycling — no override — built-in standby protection. Factory assembled . . . fits through a 2 ft. 6 in. door.

Easy to install, all cast iron, and guaranteed for 10 years . . . you can't miss with Hydrotherm.

Write for bulletin #HY-F107 and all the facts.

HYDROTHERM MULTI TEMP

HYDROTHERM, INC. • DEPT. 13HP • NORTHVALE, N. J.

EQUIPMENT DEVELOPMENTS

Continued

Electronic Air Cleaner for 2 to 5 Ton Cooling Systems

Model "UMT" with capacity selector dial removes dirt, dust, smoke, and other airborne contaminants. Built-in washer activated by turning a valve. May be floor mounted or suspended in ductwork; adaptable to horizontal or vertical air flow requirements, interchangeable for either right or left hand installation. Efficiency rating 95 percent, with particles small as 1/2,500,000 in. removed from air. Unit non-selective in particle size collected. — *Trion, Inc., 1000 Island Ave., McKees Rocks, Pa.*

Impact Wrench in ¾, 1, 1½ In. Sizes

"Swench" impact wrench builds up tension in a spring and releases this power each time handle moves 30 deg. Clicks keep worker informed each time wrench spring applies impact; tension can be gaged by number of clicks. — *Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22.*

Prefabricated Air Duct Molded from Glass Fibers

Air duct encased with an air-tight vapor barrier acts as thermal insulation and sound absorber as well. Sizes same as standard galvanized sheet metal furnace pipe, furnished in 6-ft sections. Suited for present heating with future cooling possible without need of additional insulation or vapor sealing. — *Armstrong Cork Co., West Liberty St., Lancaster, Pa.*

For the first time!

Everything you need in Dial Thermometers for Piping *and* Duct work!

A new and complete line of instruments: Dial thermometer of Marsh precision and accuracy designed down to the last detail for piping and duct work . . . for use on heating and cooling equipment, air ducts, vessels and kilns, ovens and similar applications.

Easier to read

Illustrations tell the story. Four types, seven ranges—72 stock combinations to meet every condition. Big, legible 3½" and 4½" dials . . . easy to read in places where piping and duct thermometers must be installed. Ease of reading further increased by provision for tilting and turning dials to any desired reading angle. Line includes distant reading types that take care of remote locations.

Unbreakable—more accurate

Instead of fragile difficult-to-read glass tube thermometers you now have sturdy, unbreakable, legible Marsh Dial Thermometers. Guaranteed accurate to plus or minus one division of the scale, they have far greater *readable* accuracy than any glass tube type. All have the famous Marsh "Recalibrator"—to *keep* them accurate.

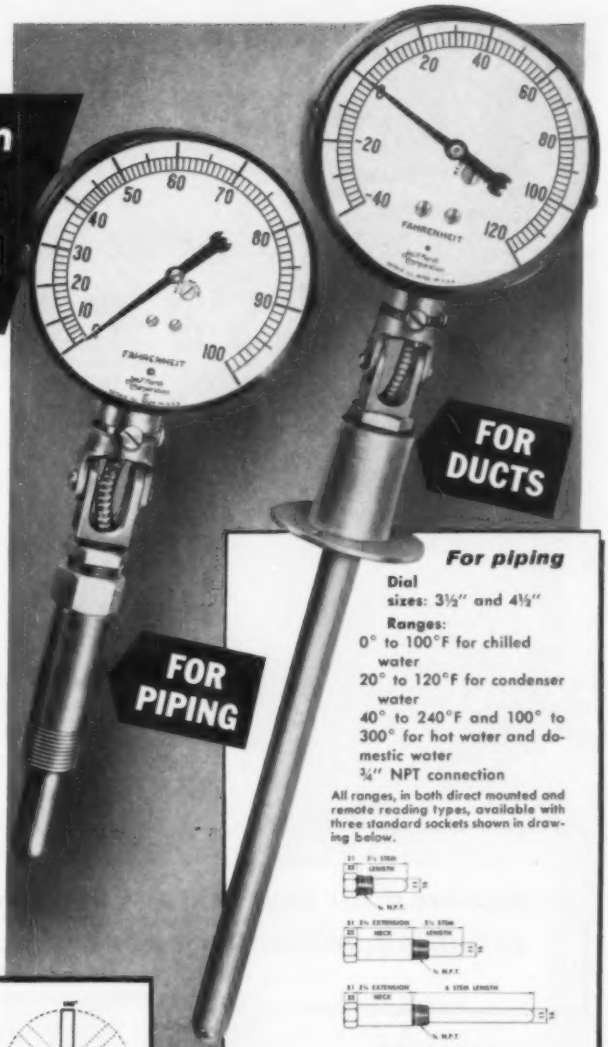
All purpose

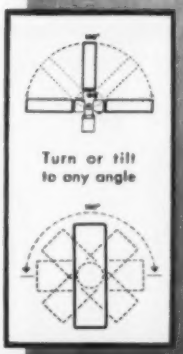
Design provides for every on-the-job condition. Separable sockets ("wells") simplify installation—or removal for servicing. Extension necks take care of insulation on piping or ducts. Long stems in duct type put temperature-sensitive section where it belongs.

Note the brief specifications opposite. Any thermometer is available from stock.

Write for bulletin telling the whole story.

MARSH INSTRUMENT COMPANY, Dept. T, Skokie, Ill. *Division of Colorado Oil and Gas Corporation* • Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103 St., Edmonton, Alberta • Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas • Eastern Seaboard Warehouse: Marsh Instrument Co., 1209 Anderson Ave., Fort Lee, N.J.





For piping

Dial sizes: 3½" and 4½"

Ranges:
0° to 100°F for chilled water
20° to 120°F for condenser water
40° to 240°F and 100° to 300° for hot water and domestic water
¾" NPT connection

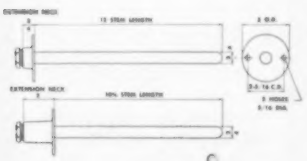
All ranges, in both direct mounted and remote reading types, available with three standard sockets shown in drawing below.

For ducts

Dial sizes: 3½" and 4½"

Ranges: −40° to +120° F
0° to 160° F
0° to 220° F

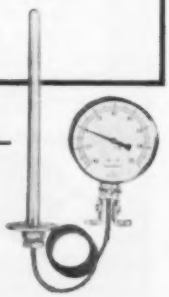
All ranges, in both direct mounted and remote reading types, available with standard extension necks and stems shown in drawing below.

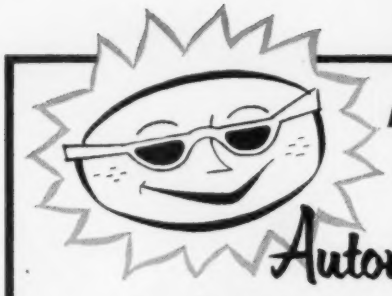


MARSH
DIAL THERMOMETERS

Also remote reading—

Piping and duct thermometers of same basic design available with 6 ft. of capillary tubing as shown.





Rely on dependable

BASMOR

Automatic Sunshine

to meet big heating demands!

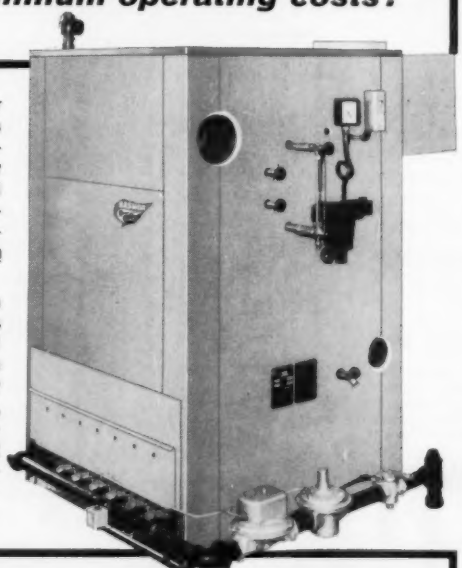
AUTOMATIC SUNSHINE is radiant hydronic heating with a Basmor Boiler. The healthful even, sun-like warmth of heat by radiation, whether from radiant baseboard, panels, convectors or conventional radiators.

Basmor Gas-Fired Boilers in sizes to meet commercial, institutional and industrial heating demands efficiently and economically. For all steam, hot water or vapor systems, and large volume water heating by the indirect method.

engineered for fast installation, simplified servicing, minimum operating costs!

Basmor 400 Series (Water Boiler shown above) in ten sizes from 375,000 to 1,050,000 BTU input. Top combustion efficiency with cast drill port burners and finest controls. Maximum utilization through patented "staggered heat travel" cast iron section design.

Basmor 600 Series (Steam Boiler at right) in thirty-six sizes from 725,000 to 5,800,000 BTU input, permits "tailored-to-the job" selection to accurately meet heating requirements. Yes, you can rely on Basmor Automatic Sunshine for big heating demands! Write for complete information.



Basmor-Little

BASTIAN-MORLEY CO., INC.
(Incorporating H. C. Little Burner Co., Inc.)
LaPorte, Indiana

Basmor-Little Boilers, Furnaces, Gas Heaters, Water Heaters, Incinerators

EQUIPMENT DEVELOPMENTS
Continued

Two Saws Cut Wood, Hardest Metals

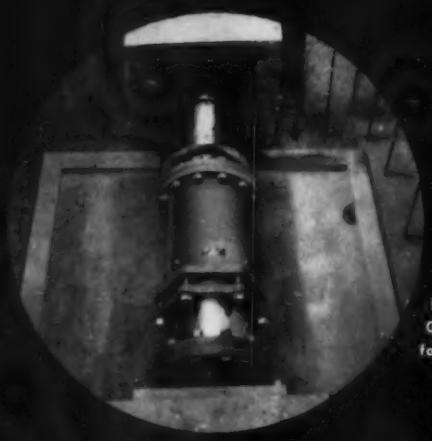
Metal cutting model cuts all metals including stainless steel. Portable unit has blade speeds of 1000 and 1400 strokes per min. Second unit for cutting wood, composition, and plastic with blade speeds of 2600 and 3500 strokes per min. Blades mount off-center on both saws and are reversible for up or down cutting. — *Skil Corp.*, 5033 *Elston Ave.*, *Chicago* 30.

Plastic Centrifugal Blower Housings With Fan Wheels

"Duracor" reinforced plastic centrifugal blower housings with "Duracor" covered standard fan wheels for installation as separate components in existing exhaust systems or for use with firm's other products. Various sizes and ratings available. Units corrosion-proof. Bulletin 10-C sent on request. — *The Ceilcote Co.*, 4832 *Ridge Rd.*, *Cleveland* 9.

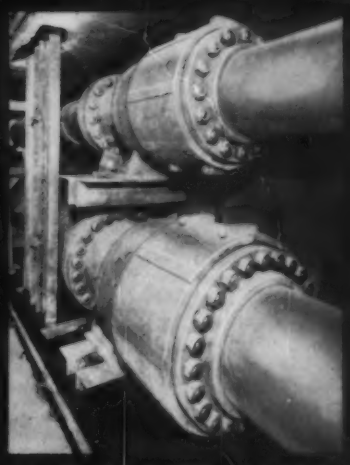
Pump Boosts Pressures In Long Distribution Lines

Submersible turbine unit boosts system pressure in distribution line. Available with capacities up to 8000 gpm, heads to 1000 ft, and motors to 350 hp. Can be installed in vertical or horizontal positions. A by-pass hook-up permits periodic inspections without interruption of service. Bulletin B-703 sent on request. — *Peerless Pump, Hydrodynamics Div., Food Machinery and Chemical Corp.*, 301 *W. Ave.* 26, *Los Angeles* 31.



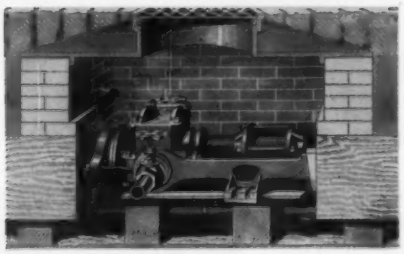
Popular type "IS" Internally Guided Expansion Joint for limited spaces.

Manhole with several Adsco Type "GIS" Externally-Internally Guided Expansion Joints.



Two Adsco 400 lb. Expansion Joints, with piston-ring feature.

Expansion Joints invented here perfected here



Adsco invented the first expansion joint (left) more than 80 years ago and today is the world's largest manufacturer of all types of expansion joints.

The Adsco Slip-Type Expansion Joints shown here are noted for the great amount of axial motion they can absorb and for rigid guiding of slip. They have long life and are easily maintained. The Adsco Piston-Ring Expansion Joint, for instance, is the only joint which can be unpacked and repacked without shutting down line pressure.

Limit stops on all Adsco Slip-Type Expansion Joints prevent the slip from being pulled out of body. Chrome-plated slip cannot be scored by metal contact as only packing touches slip. These joints are furnished in both single and double types, in a full range of sizes, with 4", 8" and 12" traverse per slip, for pressure to 400 psi and temperatures to 800° F. Special designs are available for higher pressures and temperatures.

We have been of help to thousands of piping customers since 1877. Couldn't we help you today?

ADSCO DIVISION

20 MILBURN STREET
BUFFALO 12, NEW YORK

YUBA

YUBA CONSOLIDATED INDUSTRIES, INC.

SPANG C.W. STEEL PIPE-MADE IN U.S.A.
SPANG C.W. STEEL PIPE-MADE IN U.S.A.
SPANG C.W. STEEL PIPE-MADE IN U.S.A.
SPANG C.W. STEEL PIPE-MADE IN U.S.A.

Now, all Spang CW Galvanized Steel Pipe carries this new marking which is your assurance of top-quality domestic steel pipe.

Look for this marking when you buy steel pipe

It spells two important advantages for you:

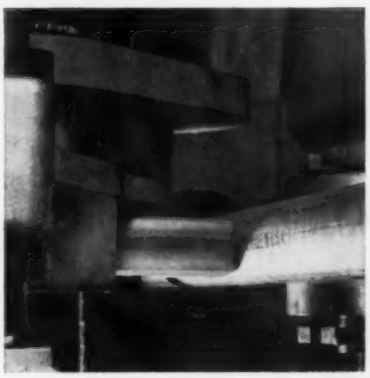
1. Pipe made in the United States of America must meet the high product standards set by definite technical specifications established for all pipe manufacturers. When you buy American-made steel pipe, you know you're getting a fine, standard product with good working characteristics and assured long life that will meet specified service requirements.

2. The SPANG CW Steel Pipe marking indicates that extra measure of quality. When you buy SPANG, you know you're getting a product that's carefully controlled during manufacturing and thoroughly tested and inspected before shipping to assure you of a top-quality product, uniform throughout, for fast, economical, trouble-free installations.

Don't take chances by making second-rate installations with questionable foreign imports. It's worth your reputation to buy Steel Pipe made in U.S.A. Look for this SPANG marking on your next pipe order. Call your nearest SPANG Distributor for service.

SPANG Steel Pipe is one of the many fine products produced by *National Supply Division, Armco Steel Corporation, 2 Gateway Center, Pittsburgh 22, Penna.*

Steel's Symbol of strength, long life, and economy



New "Made in USA" marking on Spang CW Galvanized Steel Pipe is applied after pipe has been quick-quenched following galvanizing.

ARMCO National Supply Division

EQUIPMENT DEVELOPMENTS
Continued

Combustion Indicators for New, Existing Boilers

Units supply combustion supervision and smoke indication. Every change in fuel or air adjustment or malfunctioning of furnace, burners, or controls indicated without observational lag. Red and green lights on panel act as signals. Literature sent on request. — *Photomation, Inc., 96 S. Washington Ave., Bergenfield, N.J.*

Relief Valves Offered for Hydronic Service

A 1 in. ASME safety relief valve with 30 psi rated at 1,215,000 Btu per hr for hot water heating systems. Horizontal flow control valves in 2½ and 3 in. sizes with threaded inlet and four-bolt flange outlet. Vent tapping on inlet side and can be connected to pressure tank or equipped with a float vent. — *H. A. Thrush & Co., Peru, Ind.*

Full Flow Lubricant Dispensers for Compressers

Oil or other liquids delivered by gravity through ½ in. OD nylon or metal tube from a central location when valve of dispenser is opened. Flow stops when valve is closed. Available in 10 oz, 1 pt, 1 qt, 2½ qt, and 1 gal sizes. Reservoir assemblies solid brass, brush brass lacquer finished, available with "Pyrex" glass or "Lucite" reservoir cylinders. Bulletin No. 41 sent on request. — *Trico Fuse Manufacturing Co., 2849 N. 5th Ave., Milwaukee* 12.

the weil TVC LOW RETURN CONDENSATE PUMP

10 GALLON RECEIVER
For single units. Diameter 21". Height of return above floor 6⅞".

15 GALLON RECEIVER
For single or duplex units. Diameter 25½". Height of return above floor 7⅜".

26 GALLON RECEIVER
For single or duplex units. Diameter 25½". Height of return above floor 10½".

- LOW RETURN CONNECTION
- LOW SPEED, 1750 R.P.M.
- CAST IRON · RECEIVER
- LOW WATER LINE
- Capacities to 15,000 sq. ft. EDR, pressures 10 to 40 lbs.

SELECTION TABLE

UNIT NO.	SQ. FT. E.D.R.	CAP. G.P.M.	H. P.	PUMP DISCH.	HEIGHT OF RETURN	RETURN INLET
TVC 19	750	1.5	¼	1"	6⅞"	2"
TVC 23	1000	1.5	¼	1"	6⅞"	2"
TVC 29	2000	3.0	¼	1"	6⅞"	2"
TVC 35	4000	6.0	¼	1"	6⅞"	2"
TVC 41	6000	9.0	½	1"	6⅞"	2"

DISCHARGE PRESSURE: 20 LBS. DIAMETER OF RECEIVER 21"; CAPACITY 10 GAL. FOR COMPLETE SELECTION TABLE SEE BULLETIN TVC-300.

This compact receiver and sturdy pumping unit with its low return connection and 1750 RPM motor is economical to install and guarantees a long, trouble-free life. Single units in 15 or 26 gallon receivers can be converted to duplex units at any time when load increases. Additional pump is installed on the job.

SEND FOR BULLETIN TVC-300.
STOCKED BY YOUR JOBBER

weil PUMP COMPANY
1514 N. FREMONT ST.
CHICAGO 22, ILLINOIS

There's something NEW in AIR HANDLING UNITS . . .

DUNHAM-BUSH "COMPACTS"

for COOLING • HEATING • HUMIDITY CONTROL

Compact modern design means lower shipping costs, lower installation costs, less required equipment area, more rigid assembly. 26 models are available, vertical or horizontal . . . with an overlapping range of air deliveries from 1000 CFM to 38,400 CFM.

Dunham-Bush Air Handling Units the "compact line" of the industry offers the architect, engineer, and contractor a diversified selection of floor or ceiling mounted central station units. These units are available with direct expansion, water or steam coils . . . or in combinations of these coils.

The Dunham-Bush-engineered flexibility of the component parts assures delivery of air, conditioned to fulfill any seasonal or product demand. Air can be cooled, dehumidified, filtered, heated and dehumidified . . . depending on the requirement.

Accessory equipment available includes mixing boxes, filter sections, face and by-pass dampers for close humidity control, and both water and steam spray humidifiers.

A wide range of air outlet locations and motor arrangements makes Dunham-Bush Air Handling Units easy to specify—easier to install.

For complete information request catalog 6011C

DUNHAM-BUSH

DUNHAM-BUSH, INC.

WEST HARTFORD 10, CONNECTICUT, U. S. A.

SALES OFFICES LOCATED IN PRINCIPAL CITIES

EQUIPMENT DEVELOPMENTS
Continued

Vibration Signal Analyzer For Machinery, Pipe Lines

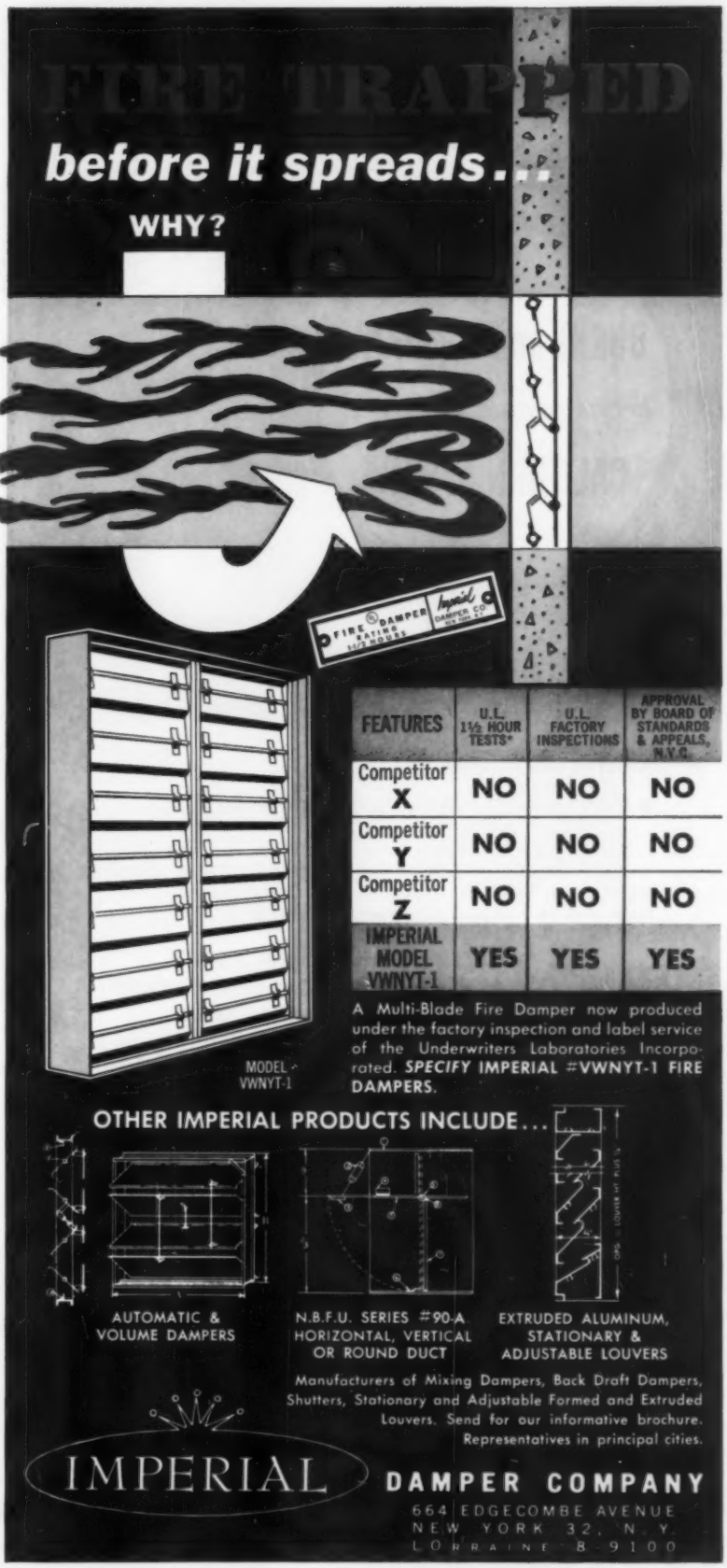
Vibration signal analyzer and portable balancer for the study and analysis of vibration sources in machinery and pipe lines. Model "41" incorporates modular construction and complete transistorized circuitry. Operates on internal battery or 110 v a-c line. Voltage selection from 50 microvolts to 100 v permits amplitude range from 5 microinches to 100 millinches, peak to peak; frequency range from 3 to 10,000 cycles per sec; and a velocity range from 50 to 100 in. per sec. — *Ray Data Corp., 1078 E. Granville Rd., Columbus 24, O.*

Bronze Valves Now Have "Teflon"-Impregnated Packings

All standard and low pressure bronze valves in firm's "O-B" line have "Teflon"-impregnated asbestos-base packings. — *Ohio Brass Co., 380 N. Main St., Mansfield, O.*

Split-Eyelet Nozzle Connectors In 1¼, 1½, 2 In. Sizes

Units in 1¼, 1½, and 2 in. sizes for connecting spray nozzles, gages, hose nozzles and similar parts. Installed to continuing or un-cut pipe or tube lengths. Split-clamp made of cadmium plated, heavy gage steel or of stainless steel. Brass or stainless steel bodies provide ½ NPT female outlet. May be used for liquids and gases up to pressures of 150 psi. Data Sheet 8370 sent on request. —*Spraying Systems Co., Bellwood, Ill.*


FIRE TRAPPED
before it spreads...
WHY?
FIRE DAMPER RATING
Imperial DAMPER CO.
MODEL VWNYT-1
FEATURES
U.L. 1½ HOUR TESTS*
U.L. FACTORY INSPECTIONS
APPROVAL BY BOARD OF STANDARDS & APPEALS, N.Y.C.
Competitor X NO NO NO
Competitor Y NO NO NO
Competitor Z NO NO NO
IMPERIAL MODEL VWNYT-1 YES YES YES
A Multi-Blade Fire Damper now produced under the factory inspection and label service of the Underwriters Laboratories Incorporated. SPECIFY IMPERIAL #VWNYT-1 FIRE DAMPERS.
OTHER IMPERIAL PRODUCTS INCLUDE...
AUTOMATIC & VOLUME DAMPERS
N.B.F.U. SERIES #90-A HORIZONTAL, VERTICAL OR ROUND DUCT
EXTRUDED ALUMINUM, STATIONARY & ADJUSTABLE LOUVERS
Manufacturers of Mixing Dampers, Back Draft Dampers, Shutters, Stationary and Adjustable Formed and Extruded Louvers. Send for our informative brochure.
Representatives in principal cities.
IMPERIAL DAMPER COMPANY
664 EDGECOMBE AVENUE
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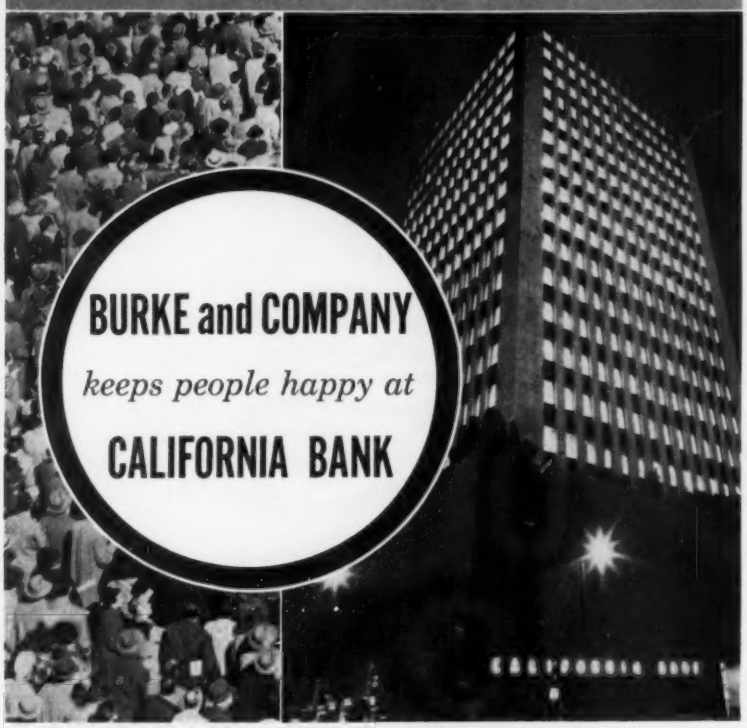
LORRAINE 8-9100

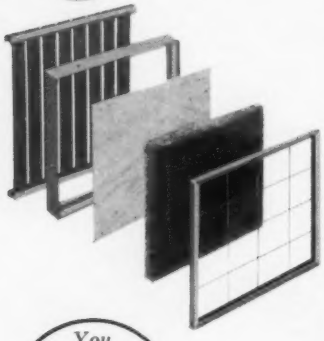
Where people gather...CLEAN PURE AIR is VITAL



ARCHITECT — Claud Beelman & Associates • GENERAL CONTRACTOR — C. L. Peck Construction & Realty Co. of Los Angeles • AIR CONDITIONING CONTRACTOR — Air Conditioning Company • MECHANICAL ENGINEERS — Kilpatrick & Company.

● Good customer relations require an atmosphere of clean, pure air for both patrons and employees. That's why in the new California Bank Building in Los Angeles ROTO AIRE replaceable media air filters, as well as both total and partial detention type gas and vapor adsorbers by Burke are being used.

ROTOAire® FILTERS STOP AND HOLD DIRT!
ACTIVATED CHARCOAL FILTERS PURIFY AIR!



Here are advance design air filters and air purifiers that are highly efficient, effective and dependable.

They are readily adaptable to all new or existing installations.

They are available in a wide variety of sizes.

They may be operated at varying velocities and with various combinations of media.

The initial cost is low, but even more important . . . the maintenance cost is low.

You can specify ROTOAire® PRODUCTS *with confidence!*

Write for Technical Data Bulletin and "Economic Analysis."

Selected Territories Available For Qualified Representatives

BURKE *and* COMPANY
2902 Hyde Park Blvd., Los Angeles 43, California

EQUIPMENT DEVELOPMENTS
Continued

Reference Voltage Source For Indicating Controllers

Unit for use with null seeking galvanometer type indicating controllers. Produces metering system with minimum time lags compatible to 5 percent or less proportioning band. Three-digit dial provides one degree adjustment of set point. Unit incorporates a Zener Diode stabilized source. Over-all measurement sensitivity 0.25 F. — *Barber-Colman Co., 1701 Rock St., Rockford, Ill.*

Copper Globe Valves In 3/8 Through 2 In. Sizes

Units rated for 125 psi working steam pressure, 200 psi water, oil, or gas. No. "424" has screw-over bonnet and swivel-type disc holder with composition for hot and cold water, interchangeable with steam disc. — *Hammond Valve Corp., 1844 Summer St., Hammond, Ind.*

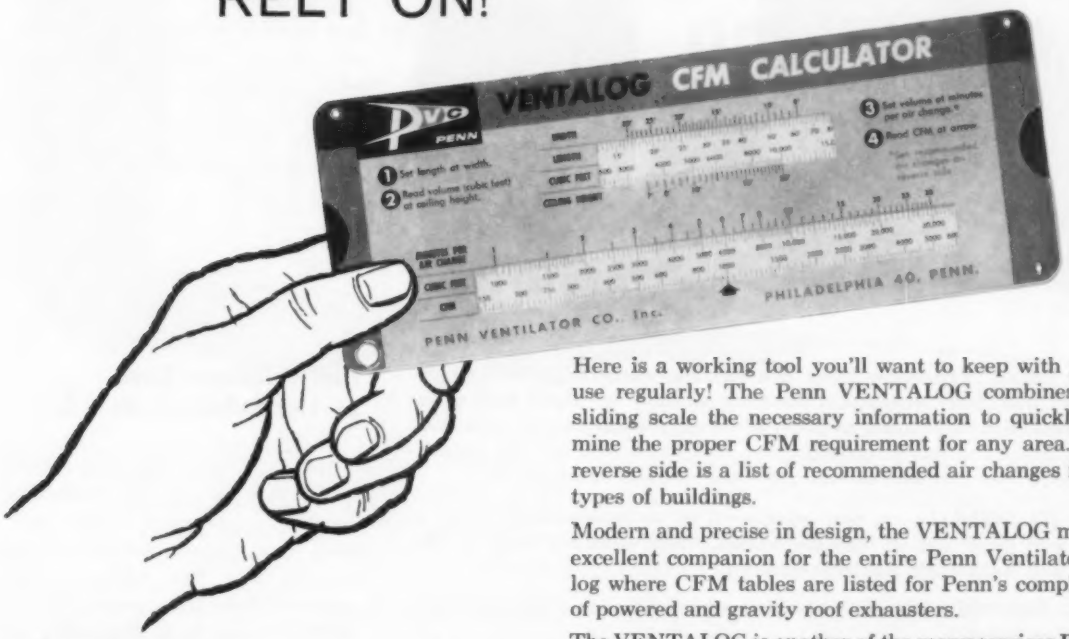
Aluminum Fluxless Solder Applied With Soldering Iron

"Tin-A-Lum" solder for use on most types of aluminum and zinc based die castings. Can be applied with any type of heat of 410 F, except flames of a sooty nature. Requires no fluxes on aluminum and its alloys, pewter, tin, and magnesium. Copper, brass, ferrous metals, and castings require normal fluxes. — *Metals for Industry Inc., 299 Pavonia Ave., Jersey City 2, N.J.*

PENN VENTILATOR **FIRST IN PROGRESS** WITH A NEW AID ENGINEERS CAN RELY ON!

NEW VENTALOG CFM CALCULATOR

helps you determine necessary CFM right on the spot!


VENTALOG CFM CALCULATOR
PENN
1 Set length at width.
2 Read volume (cubic feet) at ceiling height.
3 Set volume at minutes per air change.*
4 Read CFM, at arrow
CUBIC FEET
CFM
PHILADELPHIA 40, PENN.
PENN VENTILATOR CO., Inc.

Here is a working tool you'll want to keep with you and use regularly! The Penn VENTALOG combines in one sliding scale the necessary information to quickly determine the proper CFM requirement for any area. On the reverse side is a list of recommended air changes for most types of buildings.

Modern and precise in design, the VENTALOG makes an excellent companion for the entire Penn Ventilator Catalog where CFM tables are listed for Penn's complete line of powered and gravity roof exhausters.

The VENTALOG is another of the many services Penn has provided for Specifying Engineers and Architects to aid them in their complex task of producing the best in buildings . . the most efficient way! Contact your local Penn Representative for your free VENTALOG, or write direct.

PENN VENTILATOR CO., Inc.
PHILADELPHIA 40, PENNA.

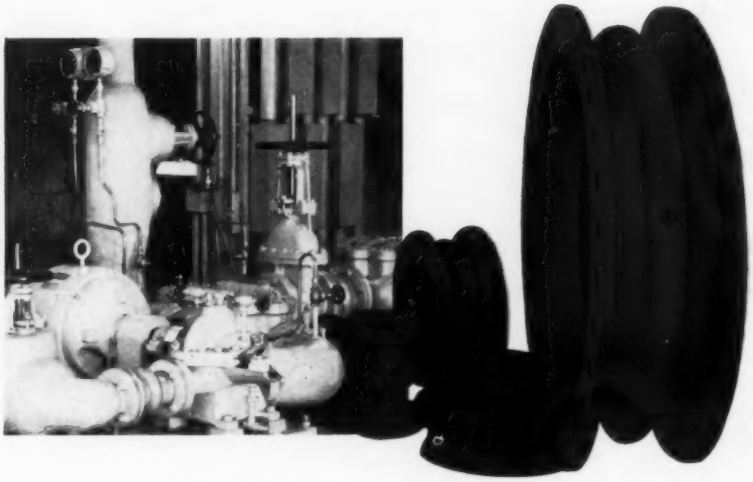
A leading manufacturer of Powered and Gravity Roof Exhausters and Accessory Equipment for over 30 years.

Member of AMCA

Penn Ventilator products are available throughout the Free World.
One of many direct factory representatives at your service:

SLAWSON EQUIPMENT CO., CLEVELAND & AKRON, OHIO

Save... ON INSTALLATION AND REPLACEMENT COSTS *With* GOODALL *Rubber* EXPANSION JOINTS



Goodall Rubber Expansion Joints are flexible, durable connections for pipe lines and other equipment handling virtually all fluids and gases under pressure and vacuum, to prevent excess stresses due to expansion and contraction; to counteract vibration; and to insulate against undesirable sound. They can also be designed to overcome misalignment.

EASIER TO INSTALL—on new equipment or as replacements. Light in weight, with short face-to-face dimensions. Metal retaining rings quickly aligned and bolted. No gaskets required.

LONGER SERVICE LIFE—no embrittlement or corrosion. High resistance to abrasive wear.

STYLES, SIZES AND PRESSURES TO MEET ALL REQUIREMENTS

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"If it's GOODALL, it MUST be Good!"

Standard of Quality—Since 1870

HOSE · BELTING · FOOTWEAR · CLOTHING AND OTHER INDUSTRIAL RUBBER PRODUCTS

GOODALL *Rubber Company*

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

BRANCHES AND DISTRIBUTORS THROUGHOUT THE UNITED STATES. IN CANADA: GOODALL RUBBER CO. OF CANADA LTD., TORONTO.

EQUIPMENT DEVELOPMENTS

Continued

Reaction Dehydrator for Air Conditioning

A chemical reactivating dehydrator in varying sizes for air conditioning systems from three to 100 hp. Unit attaches to pressure line of central system. Includes acetylenogens, hellos capacitators, and molecular aluminates. — *Federated Electronics Inc., Jamaica, N. Y.*

Nibblers Available in Air Powered, Electric Models

Units cut up to 10 gage stainless steel or 5/16 in aluminum. Cuts inside circles, squares, odd-shaped holes. No binding, chipping, curling or flaking; edge of metal smooth. — *Fenway Machine Co., Inc.*, 1910 *N. Marshall St., Philadelphia* 22.

Heat Exchanger Rated At 12,000 Btu per Hr

Self-contained package measures 24 × 15½ × 20 in. and consists of positive displacement gear type pump, reservoir, radiator coil for heat removal, fan, flow indicator, and associated fluid fittings. Unit rated at 12,000 Btu per hr in continuous use with ambient air 100 F and inlet water temperature 180 F. Provision made for a ⅝ in. OD copper or aluminum tube to be run on pressure side. Pump capable of delivering 1.25 gpm with discharge pressure adjustable up to 100 psi. Fan and pump mounted on motor shaft. Unit wired for 115 v, 60 cycle, but can be changed to 230 v service. — *The Strong Electric Corp.*, 563 *City Park Ave., Toledo* 1, *O.*

THESE FIGURES tell the STORY

...on underground insulated piping systems!!

TYPE OF SYSTEM	% OF NATIONAL PURCHASES IN 1960
AIR TESTABLE	93½%
FILL-TYPE	6½%

New... Cost Report

This Insulation Efficiency Cost Report shows how a small efficiency loss can cost you over $2,000.00 a month in higher heating bills . . .

Ninety-Three percent of the people responsible for specifying underground distribution piping overwhelmingly choose an air-testable system. These figures tell the story and are based on actual orders placed. What's the answer! . . . AN INSTALLED 15 LB. PRESSURE TEST. It offers assurance of a tight, leak-proof system. In short . . . if air cannot escape . . . surface water cannot get in . . .

Write for illustrated catalog and if you do not have our new cost report . . . ask for a copy along with the catalog.

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL PREFABRICATED **INSULATED PIPING SYSTEMS**

CENTRAL OFFICE: RIC-WIL INCORPORATED, BARBERTON, OHIO
WESTERN STATES: RIC-WIL INCORPORATED, WESTERN DIVISION, NEWARK, CALIFORNIA
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide
Changes that Danger Zone
to a
SAFETY ZONE

—enables you to
ADD PLANT AREA

If re-aligning equipment will yield more working space, better production, lower costs—do it now. Save all space wasted for placing ladders to reach overhead valves. At the same time, convert Danger Zones to Safety Zones. Equip every overhead valve wheel in your plant with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. Just phone your mill supply salesman or contact us direct.

Babbitt 168-B
STEAM SPECIALTY CO.
8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

EQUIPMENT DEVELOPMENTS
Continued

Silver-Brazing Flux For All Silver Alloys

A micro-ground, production silver-brazing flux for torch, furnace, or induction brazing on stainless steel, nickel alloys, copper, brass, bronze, steel, berrylium-copper, and all silver alloys. Homogenized "S-200 Brazaloy" flux has active temperature range between 600 and 1800 F. — *All-State Welding Alloys Co., Inc., White Plains, N.Y.*

Portable Vacuum Pumping System Available in Kit

System comprises a two-stage rotary gas ballast vacuum pump and motor for evacuating air conditioning units. Pumps these units to pressures of 50 microns of mercury or below. Pump inlet has ¼ in. female pipe thread fitting. — *NRC Equipment Corp.*, 160 *Charlemont St., Newton* 61, *Mass.*

PocketSize Dynamometer For On-The-Job Service

Unit measures torque and power loading of electric motors on-the-job. Instrument slipped onto a shaft, with collet tightened by hand. Self contained V-belt pulley adjustable from 2 to 3½ in. diameter, with adapter provided for direct drive to hubs, spokes, gears, etc. Unit viewed by stroboscopic tachometer while rotating; torque read from a dynamometer dial; rpm read from stroboscope dial. Present model indicates torque up to 22 in-lb in either direction, accuracy within one-half percent. — *Micro Pump Corp., P.O. Box* 392, *Danville, Calif.*

ANOTHER NEW ACHIEVEMENT IN MODERN FLOW CONTROL BY CRANE

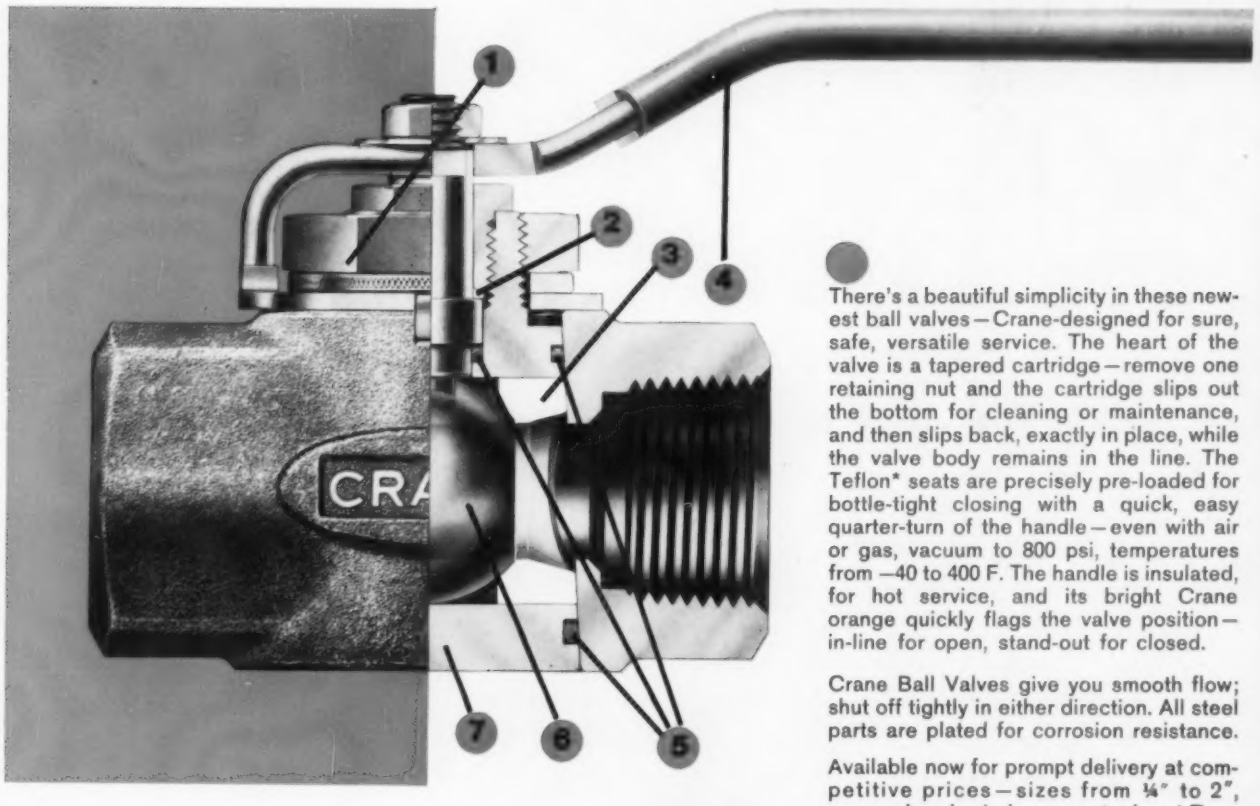
1. Single retaining nut holds cartridge assembly in body, for fast, foolproof dismantling and assembly
2. Teflon* thrust washer reduces stem friction; absorbs line pressure load on ball
3. Teflon* seats pre-loaded for tight shut-off with minimum torque
4. Bright plastic grip insulates handle and flags valve position
5. Positive, Standard Size O-ring seals on stem, cartridge
6. Self-aligning, precision-machined ball, polished and chrome-plated to minimize friction and wear on seats.
7. Tapered cartridge contains all working parts; slips out bottom in one piece for cleaning or maintenance

* Teflon is a registered trademark of E.I. DuPont de Nemours & Co., Inc.

CRANE BALL VALVES

with the exclusive tapered cartridge that drops out for fast, in-line servicing

designed to handle all air and water services to 400 F



There's a beautiful simplicity in these newest ball valves—Crane-designed for sure, safe, versatile service. The heart of the valve is a tapered cartridge—remove one retaining nut and the cartridge slips out the bottom for cleaning or maintenance, and then slips back, exactly in place, while the valve body remains in the line. The Teflon* seats are precisely pre-loaded for bottle-tight closing with a quick, easy quarter-turn of the handle—even with air or gas, vacuum to 800 psi, temperatures from —40 to 400 F. The handle is insulated, for hot service, and its bright Crane orange quickly flags the valve position—in-line for open, stand-out for closed.

Crane Ball Valves give you smooth flow; shut off tightly in either direction. All steel parts are plated for corrosion resistance.

Available now for prompt delivery at competitive prices—sizes from ¼" to 2", screwed ends, in bronze, steel and Type 316 stainless.

Call your Crane Distributor or send today for a complete, illustrated folder on the outstanding new Crane Ball Valves, engineered for unmatched service.

CRANE

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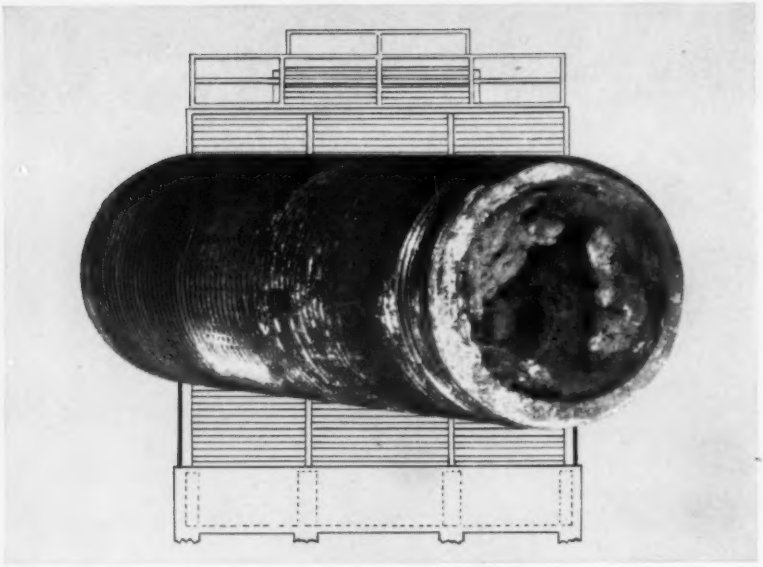
Valves/Electronic Controls/Piping/Plumbing/Heating/Air Conditioning



COOLING WATER CORROSION MUST BE STOPPED!

Unchecked scale deposit and corrosion in your air conditioning system can cut its life by years . . . increase maintenance and replacement problems several-fold.

Bird-Archer Series 5900 chromate formulations stop severe scaling and corrosion easily, effectively and economically, adjust pH to safe, neutral ranges. In small systems, treatments are added to the circulating water directly from the shipping container through a specially designed Micro-Feeder, eliminating the necessity for manual, daily chemical feeding. For larger units special chemical feed equipment is available.

Write for Bulletin 117 and the name of the Bird-Archer Service Engineer nearest you.

BA-100

BIRD-ARCHER
WATER TREATING CONSULTANTS
The BIRD-ARCHER Company, 4337 N. American St., Phila. 40, Pa. / New York • Chicago
The BIRD-ARCHER CO. of California, 415 Brannan St., San Francisco • Offices in Canada and Mexico

EQUIPMENT DEVELOPMENTS
Continued

Preformed Insulation for Standard Pipe Fittings

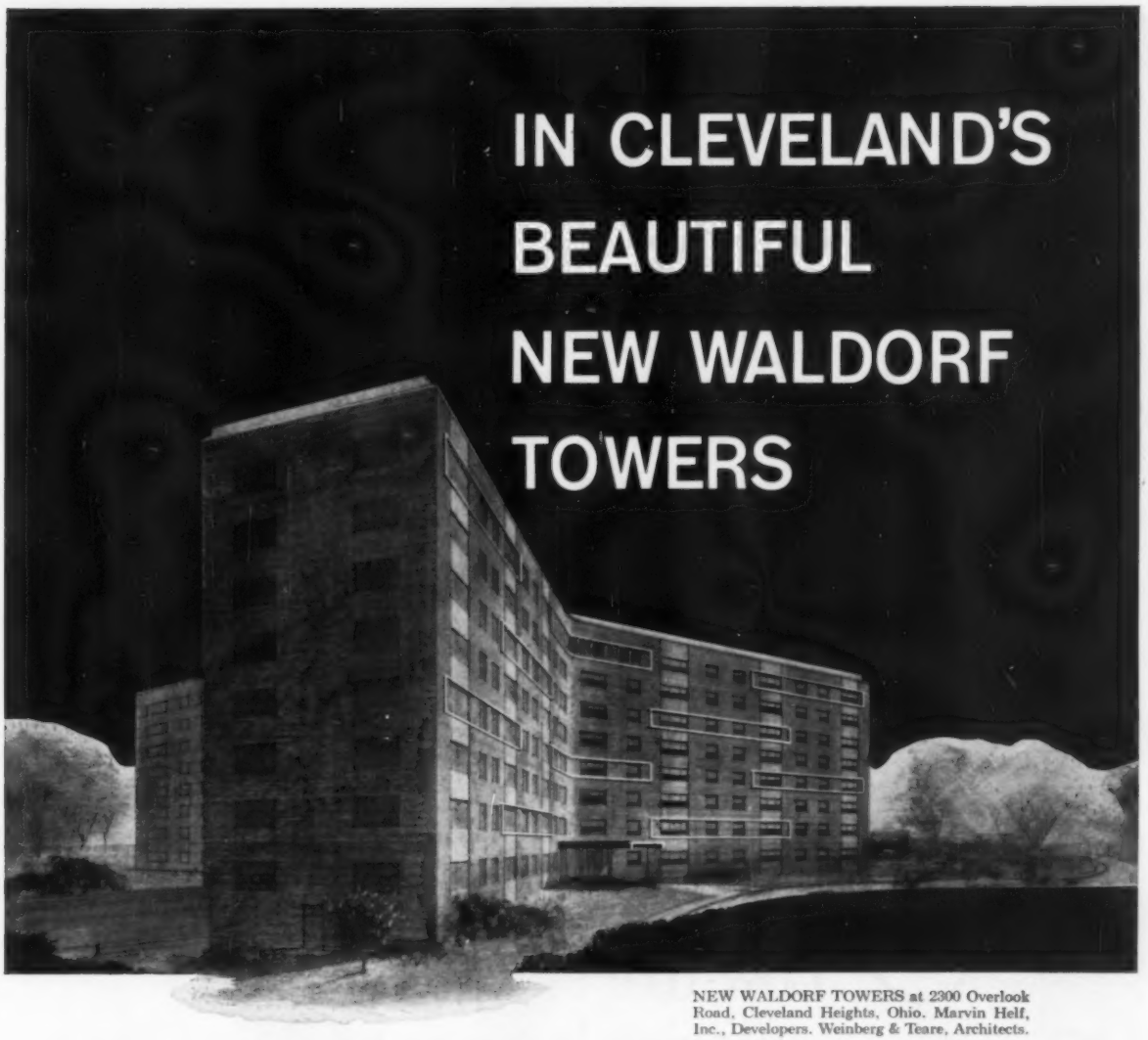
Preformed shapes of extra fine glass fibre wool bonded and molded to fit standard pipe fittings. Uniform thickness, moisture absorption of less than 0.2 percent by volume. Can be used with temperatures to 450 F. Available for butt welded and screwed fittings in 90, 45 deg ells and tees. Also for copper tubing, cast and wrought fittings. Catalog sent on request. — *Houston Reinforced Plastics Co., Inc., P.O. Box* 19486, *Houston* 24.

Portable Rotary Hammer Gasoline Operated

Unit uses shock waves for drilling rock, reinforced concrete, or masonry. Powered by a heavy-duty McCulloch gasoline engine, unit develops 40,500 shock waves and 8250 impacts per min. Withstands up to 5000 lb side-pressure. Has free-floating anvil action. Catalog sent on request. — *Demo Tool Corp.*, 1001 *Colorado Ave., Santa Monica, Calif.*

Socket Weld Tube Fittings Available In Various Metals

Units for applications involving problems of corrosion, pressure, and temperature. Will provide leak-proof performance under stress of vibration and shock. Available in aluminum, brass, inconel, nickel, stainless steel, and steel, in standard sizes from 1/8 through 1 in. OD tube. Custom sizes, materials, and shapes also available. — *Cajon Machine Co.*, 902 *E.* 140*th St., Cleveland* 10.



NEW WALDORF TOWERS at 2300 Overlook Road, Cleveland Heights, Ohio. Marvin Helf, Inc., Developers. Weinberg & Teare, Architects.

STEEL PIPE TRIMS THE COST OF WASTE LINES AND VENTS

Thousands of dollars were saved because low-cost steel pipe, good for the life of the building, was used in this 4.5 million dollar apartment.

Spohn Heating & Ventilating Company, Mechanical Contractors, based their decision on experience . . . years of *very good* experience with Republic Steel Pipe.

Republic concentrates on quality of steel. You can clock the difference in cutting, bending, threading, and joining. This pipe is easier to work, every time.

Your Republic distributor delivers pipe as you need it on the job. Call him today or write Republic Steel Corporation, Dept. HP-1822, 1441 Republic Building, Cleveland 1, Ohio.

Steel
Strong
Modern
Dependable

CALL FOR REPUBLIC PIPE

ELECTRIC WELD • SEAMLESS • BUTT WELD • X-TRU-COAT • LIGHT WALL • PLASTIC PIPE

REPUBLIC STEEL

EQUIPMENT DEVELOPMENTS

Continued

Roof Ventilators Have 194 to 2788 Cfm Capacities

Direct drive centrifugal roof ventilators in eight wheel sizes with capacities from 194 to 2788 cfm. Standard models equipped with open motors with ball bearings and are mounted in rubber for quiet operation. Aluminum fan wheel of the backwardly inclined, non-overloading type. Fan wheel housing and motor hood also aluminum. Housing available in three sizes. — *American-Standard Industrial Div., Detroit* 32.

Metal Forming Machine for Both Sheets and Angles

Combination units have initial type sheet bending roll in capacities from 20 gage to 7/16 in. in widths up to 122 in., and an angle bending roll for angles from 1 × 1 × ¼ to 2½ × 2½ × ¼ in. Rolls of initial type bending roll have extended journals with adjustable guide rollers and interchangeable roll heads for forming many shapes. — *Hendley & Whittenmore Co.*, 100 *Blackhawk Blvd., South Beloit, Ill.*

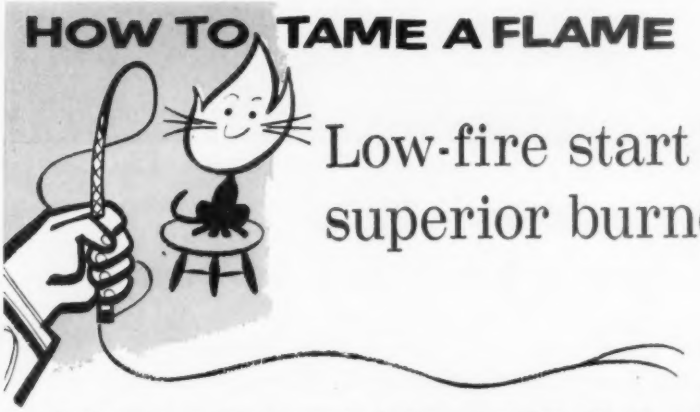
Wound Rotor Motors Available In Small Frame Sizes

Units in frame sizes from 182 through 326-U. High starting torque applied in a slow-speed step, with full operating speed reached through a series of steps. Available in standard power ratings from ½ through 40 hp, with special rating of 2½, 4, 8¾, 12½, 17½, 22½, 27½, 32½, 35, and 37½ hp. Aluminum alloy frames drip proof or totally enclosed. Mounting can be horizontal, ceiling, or sidewall. — *Reuland Electric Co.*, 3001 *W. Mission Rd., Alhambra, Calif.*

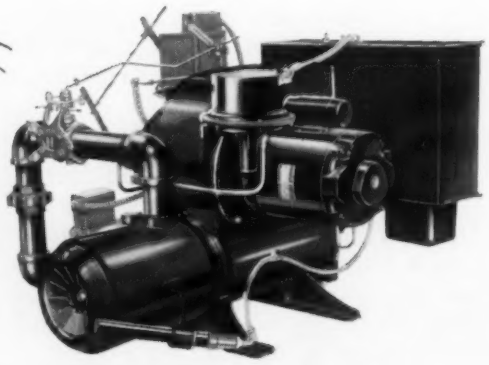
Sequence Control Features Thermal Rods for Time Delay

Sequence control for electric heating furnaces with thermal rods providing necessary time delay in turning on different heating elements one by one. Stainless steel rod heated by small electric coil activated by room thermostat. Heat elongates rod, closing a switch on main circuit. Control furnished in modules corresponding to number of heating elements in furnace. Operation not affected by variations in ambient temperature. — *Controls Co. of America*, 9555 *Soreng Ave., Schiller Park, Ill.*

HOW TO TAME A FLAME



Low-fire start leads to superior burner performance



Bringing up a flame properly is the secret of the Hev-E-Duty power gas burner's amazing performance. Automatic electric spark ignition — then low fire gives safe, smooth start every time. Flame builds up gradually to required size — air and gas are metered and mixed in perfect proportion at low to high fuel rates for efficient combustion.

Complete package! Factory guaranteed! Simple installation! Sizes from 720,000 to 21,000,000 Btu. Also combination gas/oil models. Hev-E-Oil burners — models from 5 to 150 gph. For full flame facts write Dept. HPA-31.

INDUSTRIAL COMBUSTION INC.

EXECUTIVE OFFICE: 4507 N. OAKLAND AVE.
MILWAUKEE 11, WISCONSIN

HEV-E-DUTY
POWER GAS BURNER

9-60R

Exclusive on the Versare Liquid Chiller

New indicator system pin points trouble spots

Pilot lights greatly simplify normal maintenance. Just a glance tells if oil or evaporator pressures are too low, condenser pressure is too high, chilled-water temperature is too low, or if motor is overloaded. Other lights show whether cooling switch, crankcase heater, and liquid-line solenoid valve are on. The new Versare liquid chiller is built into a structural-steel base that protects vital parts . . . slips through 36" door openings . . . has capacities from 22 to 67 tons. Write for Bulletin 3926: American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Ltd., Toronto, Ontario.

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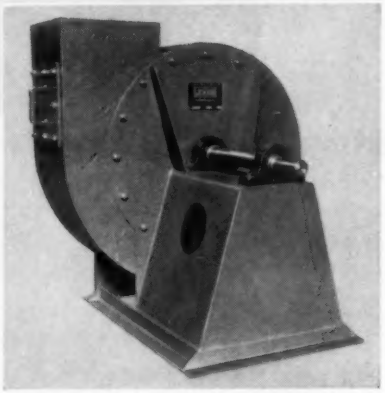
American-Standard
INDUSTRIAL DIVISION
SALES OFFICES IN ALL PRINCIPAL CITIES

This WHEEL

MAKES LEHIGH I. E. INDUSTRIAL FANS IDEAL FOR TOUGH INDUSTRIAL EXHAUST APPLICATIONS

Handles dust-laden air and gases, paper shavings and the like without clogging



Lehigh Industrial I.E. Fans . . . featuring heavy duty, unique channel construction, all-welded mild steel wheels of the long shaving design . . . solve difficult exhaust problems because of their non-clogging characteristics. They incorporate a universal housing, which permits rotation and discharge to be modified to facilitate variable field conditions.

A complete range of sizes is available in both 70° to 250°F and 251° to 600°F construction. All standard drive arrangements are available and will be furnished according to your specifications.

Rugged, air-tight construction: the fan housing is welded on the inside with a continuous fillet weld. This provides gas-and air-tight housing with joints of maximum strength.

Standard, self-aligning ball-bearing pillow blocks . . . grease lubricated . . . are featured on all Lehigh Industrial I.E. Fans.

Optional accessories include an inspection door, inlet and outlet flange, heavy duty housing construction, and drain plug.

Get detailed information on how Lehigh I.E. Industrial Fans can solve your industrial exhaust problems with dependable non-clogging performance. Your Lehigh Representative will be happy to supply you with full details. Or, if you choose, write directly to us for Bulletin L-5: 2172 LF-2

"See Chemical Engineering Catalog for details and specifications".

LEHIGH FAN & BLOWER DIVISION
FULLER COMPANY, CATASAUQUA 1, Pa.
Subsidiary of General American Transportation Corporation

TRADE LEHIGH MARK

EQUIPMENT DEVELOPMENTS

Continued

Tube Fitting Features "Snap-In" Ferrule

A "bite" type fitting consisting of body, nut, and ferrule. Suitable for air, water, coolant lines of copper, aluminum, or plastic tubing and other applications. Snap-in ferrule can be pushed in or out, but otherwise will not drop out. Bends in tubing can start adjacent to fitting's end. — *Parker Fittings & Hose Div., Parker-Hannifin Corp.*, 17325 *Euclid Ave., Cleveland* 12.

Small Expansion Valve For Air Conditioning

Unit for general replacement installations and other uses. Used with R-12 or R-22 refrigerants with "C" or "Z" power elements. Tons capacity: R-12, 0.5 to 3; R-22, 0.8 to 5. Model "900" available in both internally and externally equalized and pressure-limiting types. Valve body of high density brass forging. —*American-Standard Controls Div.*, 5900 *Trumbull Ave., Detroit* 8.

Small Automatic Temperature Control With ±1 F Accuracy

Unit 4¼ × 4 × 5½ in. maintains temperature control within ±1 F. Model "450" intended for panel mounting with visual signal indication. Available in eight standard temperature ranges between 300 and 2500 F. Special ranges also available. Heat automatically cut off in event of circuit component or power failure. — *Assembly Products, Inc.*, 75 *Wilson Mills Rd., Chesterland, O.*

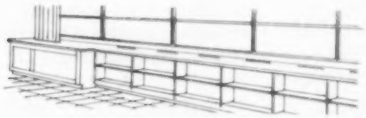
Norman schoolroom package provides

INDIVIDUAL CLASSROOM HEATING AND VENTILATING SYSTEMS

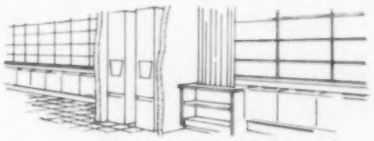
for complete comfort at low cost!

No two classrooms in a school are exactly alike in heating and ventilating requirements during the school day, due to occupancy, activity, location and other variables. So Norman Schoolroom Package Systems were installed in St. Francis Xavier School to provide true comfort in each classroom. The result was a happy combination of gas-fired forced warm air efficiency and economical construction and operating costs.

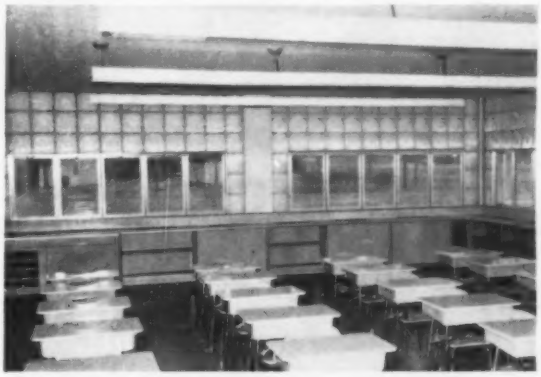
No separate building is needed to house a central heating plant. No tunnels or trenches for ducts or pipes. No unsightly chimney. Future expansion is simplified — just install additional Norman Systems as rooms are added. Other Norman gas-fired units are specifically designed for non-classroom areas.



NORMAN ENCLOSED HVS compact horizontal unit illustrated with Util-i-Duct bookshelf sections



NORMAN INN-A-WAL counter flow furnace in separate heater room, illustrated with economical Wall-i-Duct sections



School: St. Francis Xavier High School, Sartell, Minn. **Pastor:** The Rev. Frank H. Ebner

Write today for comprehensive Manual on Norman HVS Horizontal or Inn-A-Wal Counter Flow Models.

Architect: B. J. Knowles Co., St. Paul, Minn.
Engineer: Gausman, Moore, Inc., St. Paul, Minn.
Heating & Ventilating: Herb Johnson Plumbing & Heating, Sartell, Minn.

Norman® PRODUCTS CO. 1156 Chesapeake Ave., Columbus 12, Ohio

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

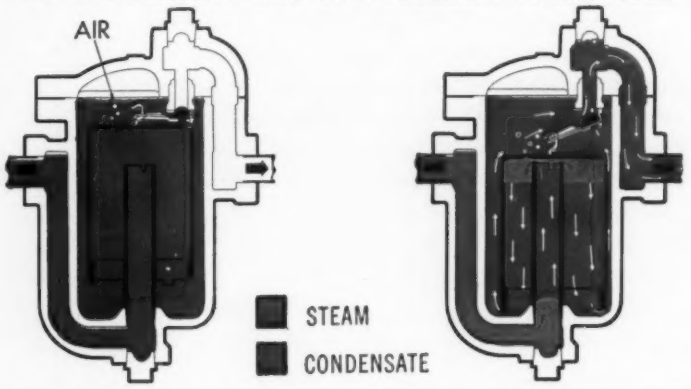
* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

Armstrong Machine Works
8743 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS
813-ST

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

See our catalog in Sweet's Plant Engineering File

EQUIPMENT DEVELOPMENTS

Continued

Differential Pressure Switch For Wide Ranges of Sensing and Control

Unit operates from differential pressures as low as 0.15 in. water gage with ranges up to 80 in. water gage. Will hold a set point through various total pressures; can be operated from plus, minus, or differential pressures in any position. Used in dust collection systems, air filters, air curtain systems, etc. Various adaptations of unit available. Bulletin No. E-40 sent on request. — *F. W. Dwyer Manufacturing Co., Dept. HA-8, P.O. Box 373, Michigan City, Ind.*

Over-Fire-Air Introducer Increases Combustion Efficiency

Unit preheats air entering combustion chamber of coal or oil installations. Preheated from 350 to 875 F, air produces more complete combustion. "Fuel Economizer" reduces smoke, soot, carbon, and sulphur deposits. Available in door mounted or inside-furnace models. Bulletins Nos. FC-2100 and FC-3100 sent on request. — *Farris Combustion Controls Corp., 400 Commercial Ave., Palisades Park, N.J.*

Electric Duct Heaters For Zoned Heating

Can be used in single or multiple installation, in parallel or in series, regardless of air travel. Handles 5.7 kw for an output of 19,500 Btu per hr. Unit has its own low-voltage transformer for activating thermostats. Time-delay switching also available to bring units on and off line at 20-second intervals to eliminate line surge or sag. — *Lennox Industries Inc., Marshalltown, Ia.*

Remote Bulb Temperature Control Has SPST or SPDT Switching

Temperature control for air conditioning systems has SPST or SPDT switching action. Opens and/or closes circuit, depending on model, at change in temperature. Unit has both Fahrenheit and Centigrade scales. Control temperature range of −20 to 450 F; maximum bulb temperature of 150 to 450 F. — *General Controls Co., 801 Allen Ave., Glendale 1, Calif.*

RIDGID
65R-TC RATCHET THREADER
with new True-Centering Workholder

Gives Better Threads Faster 4 Ways!

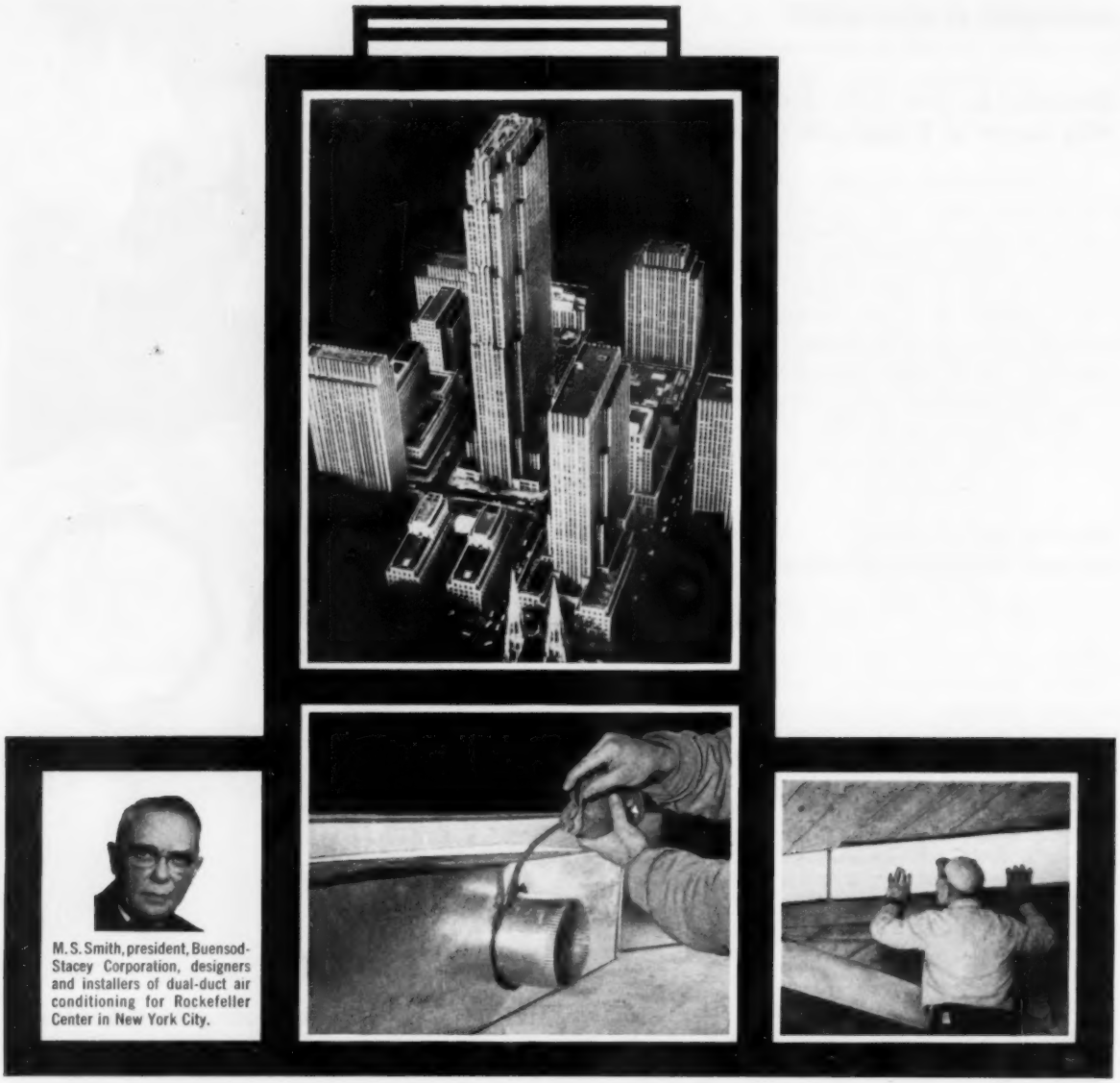
Here's Why:

One set of dies threads 1", 1¼", 1½" and 2" pipe and conduit . . . no dies to change. • Fast-to-set, True-Centering Workholder centers dies for true threads every time • Easy adjustment for accurate "drip" threads • It's jam-proof . . . automatic kick-out—prevents jamming.

RIDGID 65-RC with Cam-Type Workholder Also Available.

Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts!

RIDGID



M. S. Smith, president, Buensod-Stacey Corporation, designers and installers of dual-duct air conditioning for Rockefeller Center in New York City.

With 3M Adhesives in world's largest air conditioning system . . .

DUCTS DELIVER COMFORT WITH NO BONDING FAILURE IN 10 YEARS!

"We depend on 3M adhesives and sealers to assure tough, air-tight seals for high velocity hot- and cold-air ducts . . . and to make sure insulation really stays put. We've come to rely on the dependable performance of 3M products, as demonstrated by the Rockefeller Center job with no bonding failures in 10 years!" The report is from M. S. Smith. Over 500 Buensod Dual Duct Systems have been installed, including most of the air conditioning at Rockefeller Center. This world's largest air conditioning system has over 22,000 tons' capacity!

3M Brand Duct Sealer, applied by brush, flow gun or trowel, seals all types of sheet metal joints. It increases duct structural strength, dampens vibration and, when dry, can expand to twice its length without breaking. For insulation, there are 3M Brand Adhesives for every bonding need . . . formulations that withstand heat up to 300° F., water-based adhesives that eliminate fire hazards during application, economical high-coverage formulations for general use.

If construction is your business, 3M can serve you! 3M provides the most complete, most reliable line of adhesive products that meet every building need. Besides duct sealer and insulation adhesives, there are 3M products for bonding ceramic, clay, vinyl and rubber tile as well as wood, laminates and other materials . . . for sealing curtain-wall, other external joints and surfaces. For complete information, see Sweet's Catalog, your nearby distributor, or send for the new booklet that explains the entire 3M line. Write AC&S Division, 3M Co., Dept. SBHI-31, St. Paul 6, Minn.

ADHESIVES, COATINGS AND SEALERS DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

EQUIPMENT DEVELOPMENTS
Continued

Revolving Joint Can Handle 500 Psi Air or Hydraulic Pressure

Unit has minimum turning torque at speeds around 1500 rpm. Features case hardened steel rotor and nonporous carbon seat that aligns itself to face of rotor. Stainless steel sleeve has Buna N O-ring as a stationary seal. Rotation takes place on two precision ball bearings. Entire assembly seated by stainless steel spring. Joint casing made of alumimum. — *Rotherm Engineering Co., Inc.*, 7280 *E. Devon Ave., Chicago* 31.

Round Air Duct Combines Thermal, Acoustical Insulation

Glass fiber duct reduces heat loss and transmitted noises. Available in standard sheet metal sizes. — *Gustin-Bacon Manufacturing Co.*, 210 *W. 10th St., Kansas City, Mo.*

Welding Process Developed For Mild Steel Applications

Welding process combines the use of carbon dioxide and a low alloy steel welding wire. Welds made on tubing, piping, pressure vessels, and compressor casings using direct current, straight polarity, with CO_2 shielding gas. "Airco A602" type wire available for single or multi-pass applications with deposition rates varying from 1 to 15 lb per hr. Has tensile strength of 70,000 psi; yield strength, 60,000 psi. Available in 0.045 and 0.054 in. diameters. — *Air Reduction Sales Co., Div. of Air Reduction Co., Inc.*, 150 *E. 42nd. St., New York* 17.

SELL MORE "TOUGH CLIENTS" WITH REZNOR...

more types and sizes of direct-fired heaters to choose from!

Now you can satisfy "tough clients" with just the right model heater for every job. The Reznor line features more types and sizes than any other! Choose from:

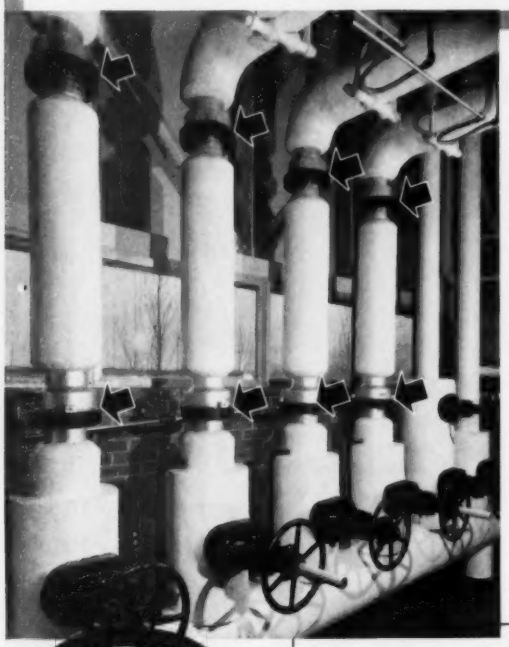
- Money-saving, space-saving unit heaters with three control options, propeller or blower fans, 25,000 to 300,000 Btu.
- Low cost, versatile duct furnaces in capacities of 50,000 to 300,000 Btu and up, for central heating, year-round air conditioning, or heating of make-up or process air.
- Matching, quiet-operating blower packages, if a separate air handler is needed.
- The new Reznor Venter, an automatic vent exhauster that lets you install Reznor unit heaters almost anywhere.
- Effective, five-way heaters for high ceiling applications, 300,000 to 600,000 Btu.

Ask your Reznor representative for a copy of Catalog SA-5900, with complete data on all Reznor heaters. Or write Dept. 51R, Reznor Manufacturing Co., Mercer, Pa.

REZNOR HEATERS

"WORLD'S LARGEST SELLING DIRECT-FIRED HEATERS"

Barco Solves Valve Piping Expansion Problem



Relieves Strain on Valves

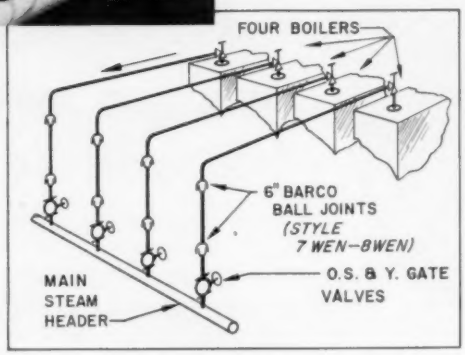
This photograph shows an interesting new installation of eight Barco Flexible Ball Joints (see arrows) on four 250 psi boiler steam lines in a West Coast industrial plant. The schematic diagram (below) shows the piping layout.

Due to the fact that operation of individual boilers is intermittent, complicated expansion, contraction, and torsional movements occur in the piping. All of these movements are easily accommodated with the aid of the Barco Joints, relieving reactive forces on the valves.

BARCO

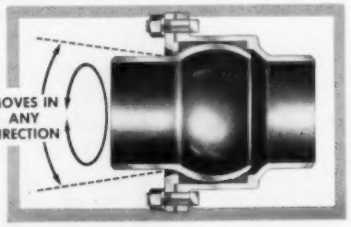
BALL JOINTS

1. Handle Expansion
2. Relieve Torsion
3. No "End Thrust"



PROBLEM—Originally, in the plant shown above, it was thought that the "spring" in the long runs of piping would take care of *thermal expansion* and *torsional stresses*. SUCH WAS NOT THE CASE. Serious trouble was encountered, tending to crack valve flanges and twisting so they would not seat tight.

ANSWER—Barco Ball Joints solved the problem, LOGICALLY, SIMPLY, ECONOMICALLY. These rugged all-steel joints have no thin wall sections, no critical points of fatigue, no rubber seals. They are practically indestructible. They provide points of flexibility in piping. Easy to engineer. They fit right in the piping; develop no "end thrust"; require no expensive anchoring. Sizes and styles to meet your requirements. *Send for catalog and information.*



BARCO MANUFACTURING CO.
5401 Hough Street, Barrington, Illinois
In Canada: The Holden Co., Ltd., Montreal

EQUIPMENT DEVELOPMENTS
Continued

Hollow Shaft Pump Motors With Capacities up to 800 Hp

Weather protected units have capacity range from 100 to 800 hp, with speeds from 400 to 1800 rpm and thrust capacities from 11,280 to 8000 lb. Available in three or two phase, 60 cycles, with Class A insulation 104 F rating or Class B insulation 140 F rating. Units more than 6 ft tall, with mounting base diameters of 30½ and 24½ in. Voltages of 220, 440, 550 v from 100 to 200 hp inclusive, and 440, 550, 2300 v from 250 through 800 hp. — *U.S. Electrical Motors Inc., P.O. Box 2058 Terminal Annex, Los Angeles 54.*

Solder Suspends Surface Oxide on Four Metals

Solder suspends surface oxide on steel, copper, brass, and galvanized iron, without sputter. Inhibits oxidation and dissolves oil and grease. Neutralized with and soluble in water. — *Farrelloy Co., 1258 N. 26th St., Philadelphia 21.*

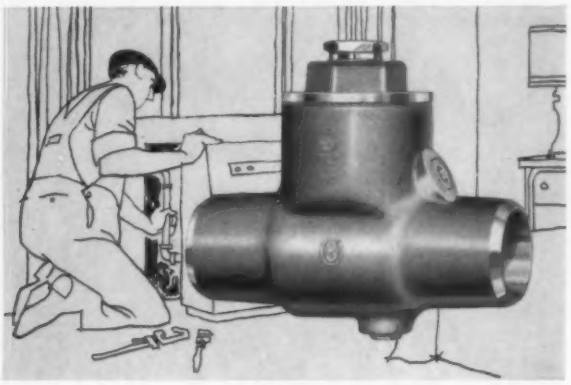
Combination Filter-Adsorber Contained in a Single Case

"Roto Aire" combination replaceable media air filters and activated charcoal air purifiers available in a single case. May be operated at various velocities, with various densities and combinations of filter media. Adsorber section comprised of a series of replaceable cartridges containing activated charcoal. — *Burke and Co., 2902 Hyde Park Blvd., Los Angeles 43.*

O-B Valves
maintain positive control...

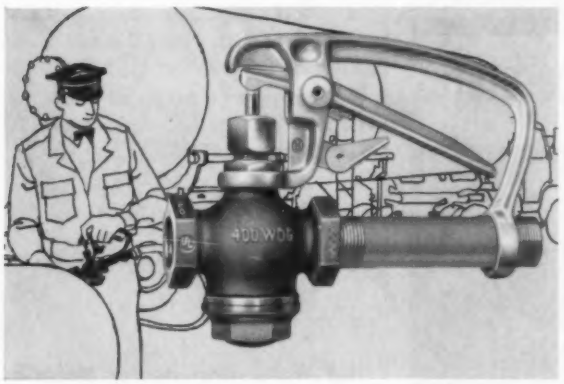
...in processing lines

Plants piping steam, water, gas, air and oil to production machinery find O-B valves hold up under severest demands. They're made for them. O-B bronze valves (like No. 1201 globe pictured) combine fine casting, precise machining and sound engineering to maintain positive flow control.



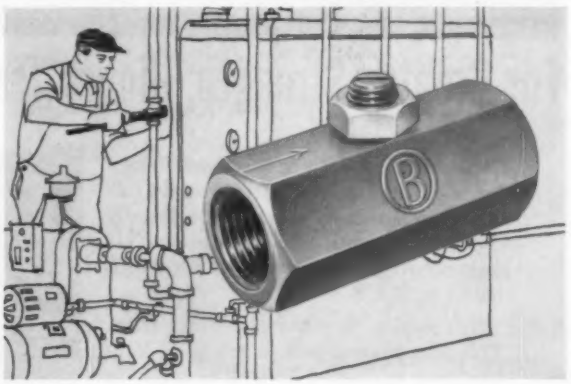
...in heating-cooling systems

Accurate heating, air conditioning and balancing of year 'round combination systems are assured by O-B "Equa-temp" valves—used also for radiant heating. A quarter turn of stem closes valve, simplifies draining without need for refilling system. Special design discourages tampering.



...in LP-gas dispensing trucks

Its exclusive construction features make this UL-listed dispensing valve ideal for transferring LP-gas from tank to tank. Body is extra heavy bronze that withstands rough handling. A stainless steel spring effects tight closure and a special latch holds valve open until it's released.



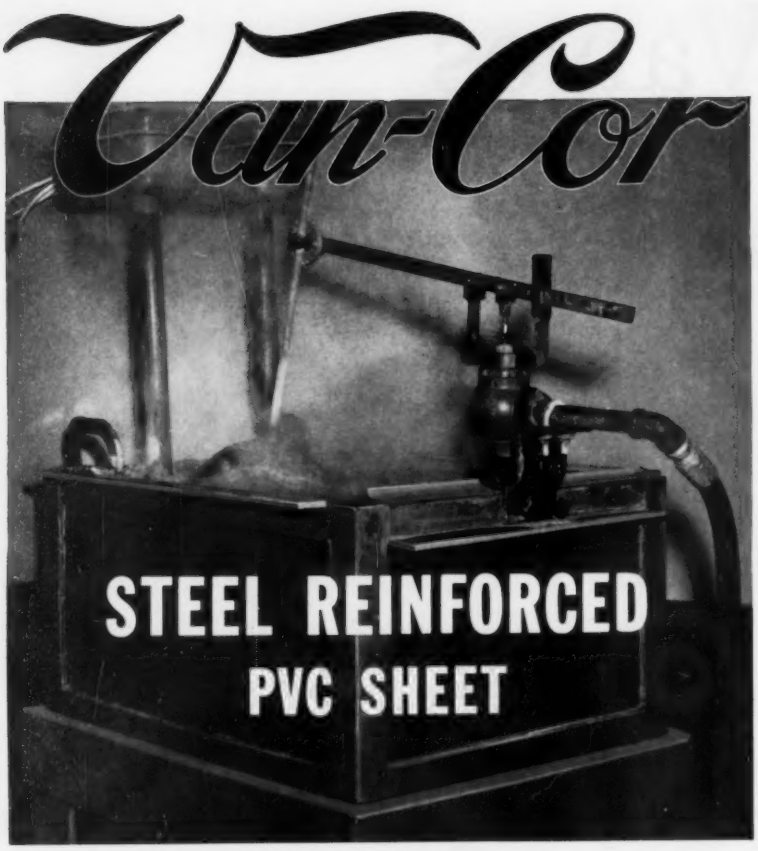
...in oil furnace feed lines

Reliable operation of oil burning furnaces is aided by this O-B bar stock valve with needle point that maintains precise regulation of fuel. Special copper base bronze stem and disc offer excellent corrosion resistance, making this valve ideal for water and gas service as well.

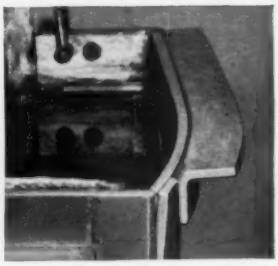
You profit most when you standardize on the O-B bronze valve line. You find the consistent quality you want—the efficient operation you rely on—and the freedom of choice you need—in valves from ⅛" to 3" sizes. Write for latest catalog information.

OHIO BRASS COMPANY • Mansfield, Ohio

Ask your distributor for the valve in the orange-and-black box



For Greater Strength, Higher Temperatures



Conventional PVC is never recommended for operating temperatures over 160°F. The small picture at right graphically shows how a tank made of regular PVC distorts within 24 hours when filled with liquid at 212°F.

By contrast, note the main illustration. This undamaged tank is made of Van-Cor steel reinforced PVC. The liquid in it was maintained *at 212°F. for 30 days!*

Resistance to high temperatures is another major new product development by Colonial to broaden the applications of Van-Cor PVC products.

Regular Van-Cor sheet without reinforcement, as well as Pipe, Fittings, Valves and Conduit continue to offer you all these benefits:

1. *Resist Corrosion of Industrial Acids and Alkalies*
2. *Light in Weight (1/2 that of Aluminum)*
3. *Easily Installed; High Tensile Strength; Low Flow Resistance*
4. *Readily Formed, Machined, Threaded and Welded*

Write for Information and Name of Nearest Distributor

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EQUIPMENT DEVELOPMENTS
Continued

Blower Motor Has Reversed Stator and Rotor

"Inside-out" blower motor reverses conventional relationship of rotor and stator. Blower wheel attached to fractional hp unit's outer element, which is the spinning element. Field windings placed in shaft assembly, which is the stator. A permanent split capacitor type, unit has direct drive. — *A. O. Smith Corp., Electric Motors Div.,* 531 *N. 4th St., Tipp City, O.*

Relay for Fractional Hp Motor Control

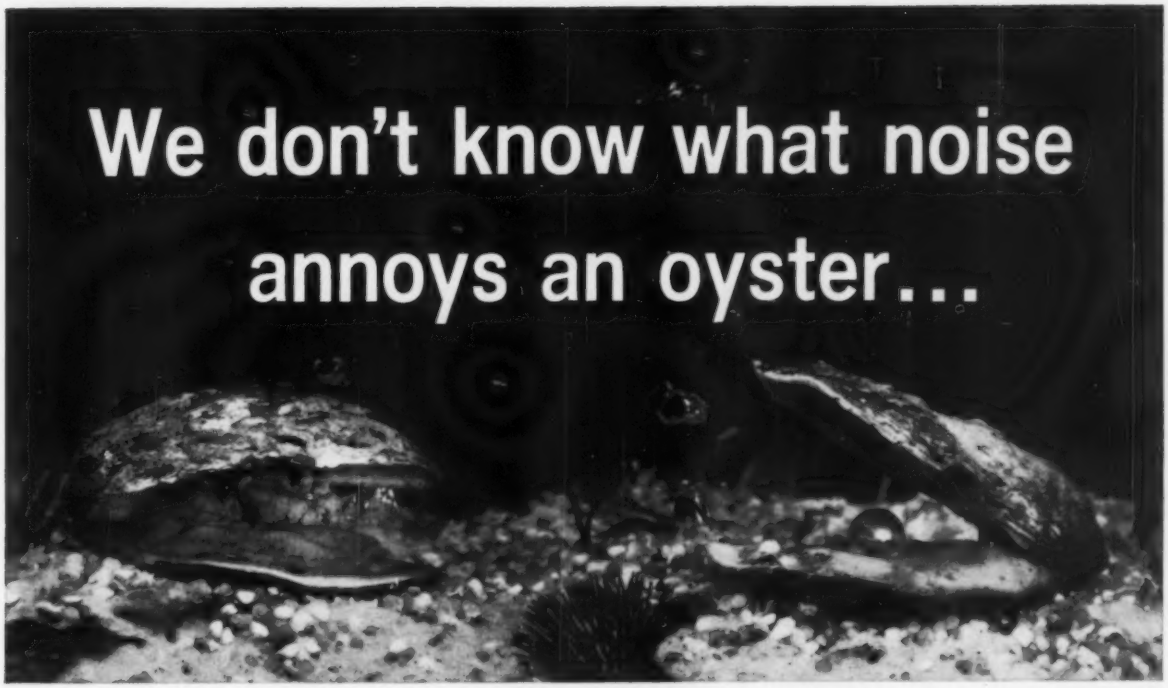
Relays for control of small, self-protected electric motors up to 3/4 hp. May also be used with solenoids and valves. Rated at 600 v and available with 6, 12, 24, 115, 230, 440, and 550 v coils, 60 or 50 cycles. — *General Electric Co., Schenectady* 5, *N.Y.*

Hot Water Unit Heater Motor Drives Both Pump and Fan

Unit contains circulating pump and fan driven by small three-speed tap winding, shaded pole type motor. Ceramic magnetic drive eliminates need of seals. Magnetic elements of barium ferrite; other elements of stainless steel, copper, and brass. Output from 5000 Btu per hr at an entering water temperature of 120 F to 16,500 Btu per hr at 220 F. No flames, vents, or high temperature elements involved. Operates on any hot water source. — *Iron Fireman Manufacturing Co.,* 3170 *W.* 160*th St., Cleveland* 11.

372

We don't know what noise annoys an oyster...



. . . but we do know plenty about eliminating *industrial* noise. Koppers AIRCOUSTAT is the *pioneer product* for controlling duct-transmitted noise in air handling systems . . . and Koppers has the *longest, broadest experience* in the whole field of industrial sound control, from air conditioning to aircraft engines.

AIRCOUSTAT® is the quality standard in its field. Its pioneer engineering is matched by premium construction that features heavier gauge metal than competitive units. It is assembled with care to give the quality performance promised by its original design. And AIRCOUSTAT provides *guaranteed* attenuation certified in the laboratories of independent research organizations.

Write today for your copy of the Aircoustat Selection Manual, a quick guide to eliminating noise in all air-handling systems, to: KOPPERS COMPANY, INC., Sound Control Dept., 3303 Scott St., Baltimore 3, Md.

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Engineered Products Sold with *Service*

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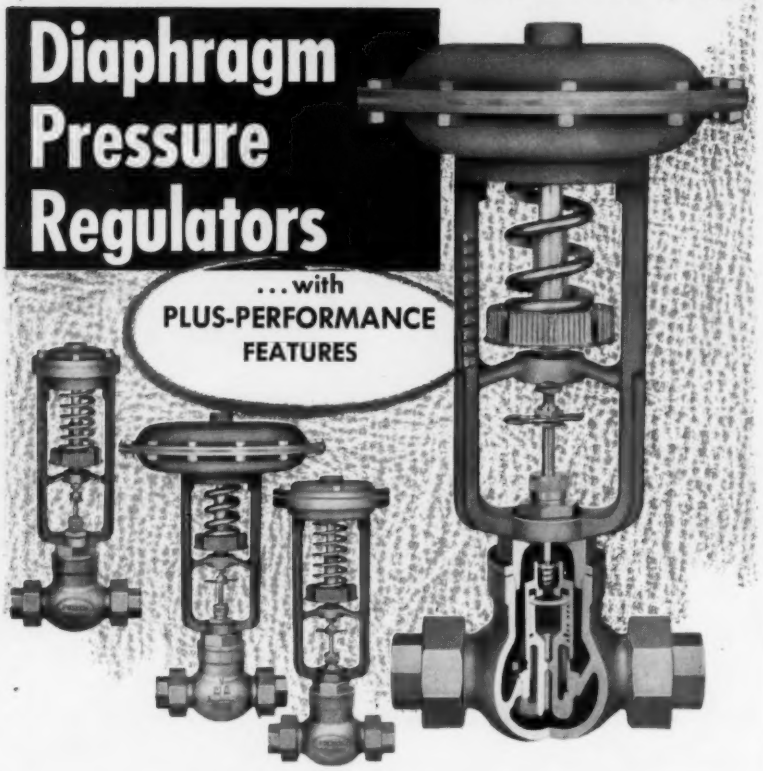
New pressure controls . . . 0.5 to 150 psig.

Diaphragm Pressure Regulators

. . . with PLUS-PERFORMANCE FEATURES



Now . . . Robertshaw engineers answer still more of your pressure control problems with these highly efficient diaphragm-actuated companions to our famous *bellows* self-ops!

Ruggedly built and modestly priced, this new 1065 Series is offered in four diaphragm sizes, with nine different ranges from 0.5 to 150 psig. Single-seated ½" to 2" valves for positive shut-off . . . piston-balanced in the larger sizes; double-seated, 2½" to 4" sizes.

- Nylon-reinforced, moulded Buna-N diaphragm
- Spring-loaded Teflon chevron lifetime packing
- Ball-bearing wheel adjustment
- Quick-disconnect, polished monel valve stem
- Stainless steel trim standard
- Highest quality chrome steel adjusting spring
- Valve designs backed by years of field service

For complete specifications, ask for Bulletin VH-125. **Fulton Sylphon Division, Robertshaw-Fulton Controls Company, Knoxville 1, Tennessee.**

Robertshaw MR. CONTROLS

EQUIPMENT DEVELOPMENTS

Continued

Air-to-Air Heat Pump Suited for Commercial, Light Industrial Use

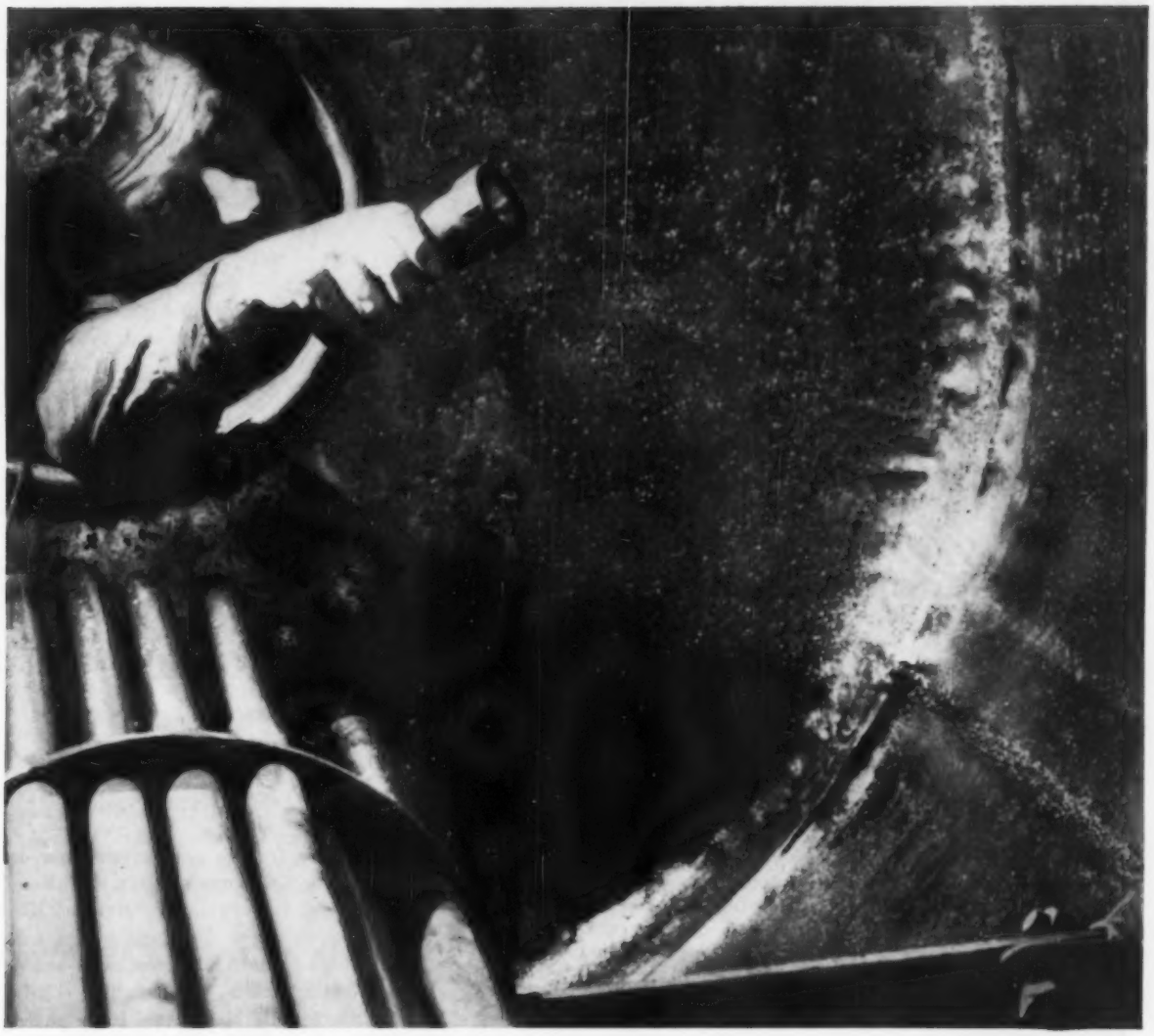
Wall-mounted heat pump supplies 18,000 Btu per hr cooling and 17,000 Btu per hr heating. Packaged units in embossed aluminum cabinets approximately 6 × 2 × 1 ft. Equipped with twin squirrel-cage blowers, driven by a ⅛ hp motor and capable of moving 650 cfm of air through the ductwork. Back panel removable, allowing access to all components. — *Westinghouse Electric Corp., 3 Gateway Center, Pittsburgh 22.*

Two-Way Radios Offered In 15-Watt Models

Two-way radios for operation in low band (27-50 mc.) and high band (150-174 mc.) with VHF-FM audio. Unit has 15 tubes and two transistors; battery drain is 4.2 amp. Control section contains transistorized power supply adaptable to 12 v negative or positive ground electrical systems. Aluminum constructed unit 4½ × 7¾ × 12½ in; weighs 10 lb, including microphone and built-in speaker. — *General Electric Co., Communication Products Dept., Lynchburg, Va.*

Portable A-C Arc Welder For Medium-Duty Service

Model "M 18 T-1" operates on 180 amp, 80 v open circuit. Allows welding with all types of electrodes from 1/16 to 3/16 in. in diameter. Unit mounted on wheels. Automatic balance volt-arc provides a deep penetrating arc at high ampere settings and a soft arc at low settings. The 15 to 180 ampere range covered in 15 steps. — *Metal & Thermit Corp., Rahway, N.J.*



Still no sign of wear or corrosion in Patterson-Kelley storage water heater

AFTER 26 YEARS OPERATION

Credit Revere Copper for this outstanding performance

The copper-lined heater you see above was installed in the Bronx County Courthouse Building, New York City, in 1932, and processes rust-free hot water for the 1,000 staff members and more than 5,000 visitors daily.

Department engineers inspected the heater annually, the last inspection being in June, 1958. At that time the above photo was taken of the heater's interior. After 26 years constant use, processing over 8,500,000 gals. of water at the average rate of 4 tons per day, the heater was found to be in excellent condition, all original fittings in good operating condition and copper tube bundles and supports showed not one sign of wear or corrosion. Once again copper has proved a most efficient, economical and durable material in storage water heater service.

Find out how copper and its alloys can help you in your corrosion problems, whether it be storage water heaters, heat exchangers, condensers or distillation units. Call on Revere's Technical Advisory Service with its great storehouse of knowledge on this subject.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
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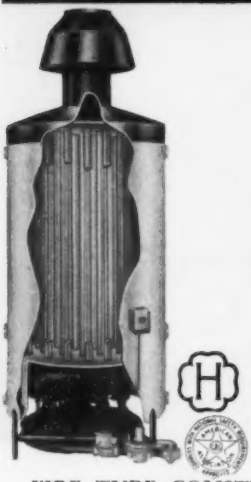
Distributors Everywhere.



The Only Heater in the World with a Protective Shield of Nickel

Alone in its class... Miracle NICK-O-LINE, the heater with rust and corrosion resistance equal to hardened stainless steel. Through chemical science's remarkable Kanigen* process, a tough, smooth, non-porous coating of nickel is chemically deposited on the heater's vital inner surfaces. The result is total protection from the destructive elements in problem water. Coupled with a highly critical quality control production technique, nickel lining means the revolutionary NICK-O-LINE will last and last and last.

FIRE TUBE CONSTRUCTION provides greater heating surface area . . . boosts recovery . . . an unlimited supply of economical hot water.

SEDIMENT RESERVOIR — Water leg design allows sediment in water to drop below critical heating surface . . . provides easy cleaning access.

COMPLETE SIZE RANGE from 80 to 600 gallons storage capacity, with recovery up to 1,500 gallons per hour.

CONTROL SYSTEM — Top quality designing by General and Minneapolis-Honeywell provides dependable and consistent operation. Features 100% automatic safety shut-off control.

PROOF OF PERFORMANCE

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EQUIPMENT DEVELOPMENTS

Continued

Flowmeter Regulator For CO_2 Welding

Atmospherically heated flowmeter regulator for gas-shielded metal-arc welding using CO_2 gas. Eliminates freeze-up in flow control equipment by isothermically expanding high pressure CO_2 gas through two stages of pressure reduction. Unit consists of a chrome-plated pre-set single stage regulator, a heat exchange coil, a second stage of pressure reduction, and a float-type variable-area pressure compensated flowmeter. — *Air Reduction Sales Co., Div. of Air Reduction Co., Inc.*, 150 *E. 42nd St., New York* 17.

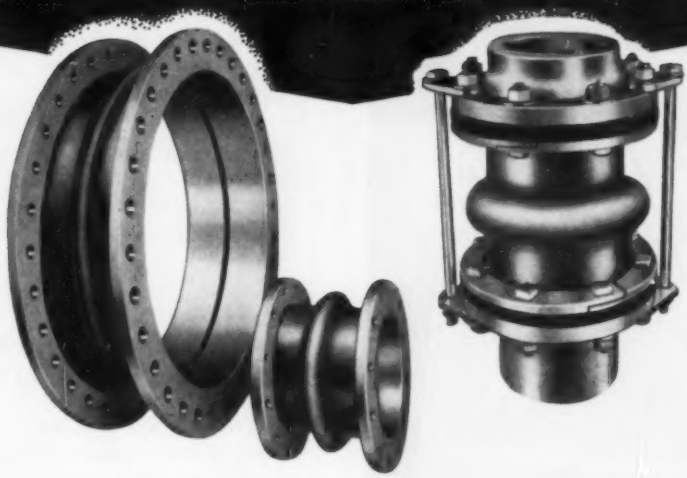
All-Purpose Saw-Knife Cuts Wood, Metal, and Plastics

Unit for use as a keyhole saw or knife. Contoured 6⅛ in aluminum handle, diecast in two sections. Has storage space for three blades and blade guard. Furnished with wood-cutting blade, metal-cutting blade, three knife blades, and blade guard. — *Stanley Tools, Dept. PD, Division of The Stanley Works*, 195 *Lake St., New Britain, Conn.*

Universal Drive Permits Drilling at 52 Deg Angle

Drive converts any power drill, ¼ to ½ in. capacities, into a variable angle tool. Will drill at angles up to 52 deg. Can be mounted directly into any drill spindle with ⅜ × 24 in. male or female thread. Furnished with threaded sleeve permitting use of either ¼ or ½ in. chuck. Catalog sent on request. — *Glenwood Gyro-Drive, Inc., Gleenwood, Minn.*

R/M Rubber Expansion Joints and Pipe Solve Piping Stress and Vibration Problems



R/M Rubber Expansion Joints *absorb* pipe movement. They respond to the slightest pressure . . . preventing stress and strain on pipe and fittings that can cause major trouble in ventilating and air conditioning systems. R/M Rubber Joints also *insulate* system components against destructive vibration and noise. Where space is limited or equipment is operated above rated capacity, R/M Rubber Expansion Joints compensate for misalignment due to stress loading. They are available in a wide range of natural and synthetic rubber types for use with gases, fluids or semi-fluids over a temperature range to 200° F.

Condor Flexible Rubber Pipe is ideal for pipe lines subject to noise, vibration, electrolysis, corrosion, abrasion or taking backbends. It will outlast iron or steel—eliminate leaky joints at bends. Let an R/M Distributor discuss with you the advantages of R/M Rubber Expansion Joints, Condor Flexible Rubber Pipe and other R/M rubber products for your heating and cooling applications. Write for Bulletin M685.

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EQUIPMENT DEVELOPMENTS

Continued

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Combustion detector does not react to radiant heat or ignition spark, but only to flame rays. Non-electric "LuXray" system may be installed in the blower end of burner where operation is unaffected by foreign matter. Can be burner or remote mounted, and used in various types of furnaces with different kinds of combustion chambers. — *General Controls Co., 801 Allen Ave., Glendale 1, Calif.*

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Multi-Boiler Heating Plant Has Step-Controlled Input Modulation

Unit composed of individual cast-iron heat exchangers with patented horizontal sections manifolded into common supply and return headers. Separate combustion chambers sequence-fired by electronic step-control. Control coordinates signals from outdoor thermostat and immersion thermostat in supply water. Input ratings from 360,000 to 3,600,000 Btu per hr, operating on manufactured, natural, or propane gas. — *Hydrotherm, Inc. Clinton Ave., Northvale, N.J.*

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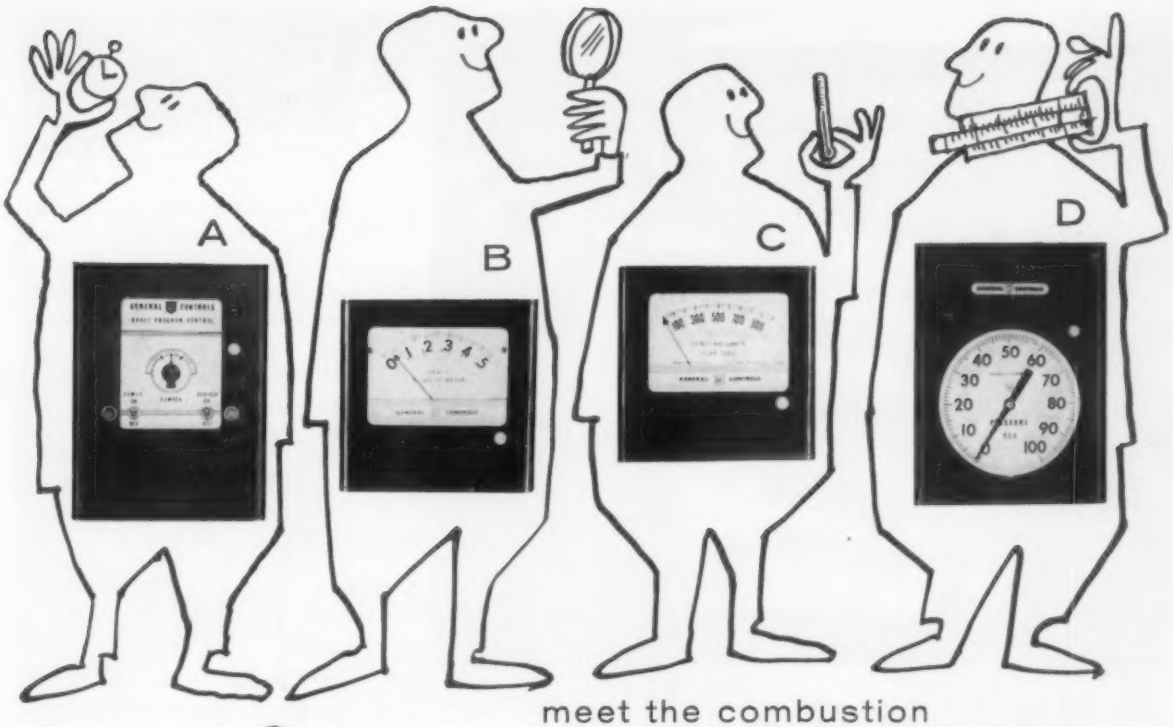

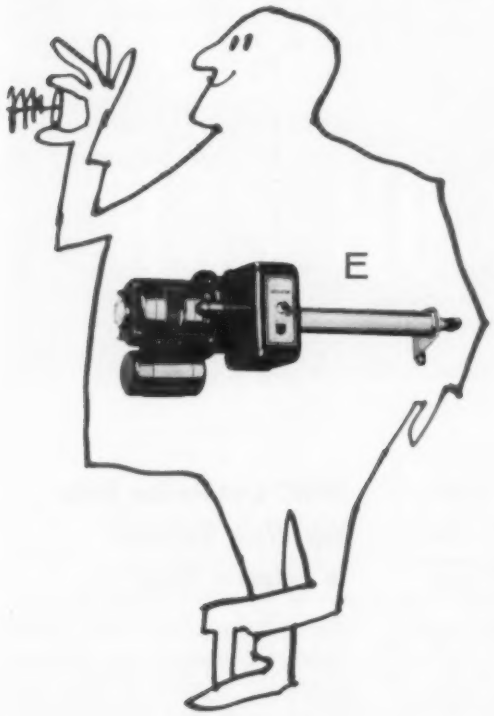

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B **DRAFT INDICATOR:** Provides continuous visual readings of draft conditions in combustion chamber and/or stack.

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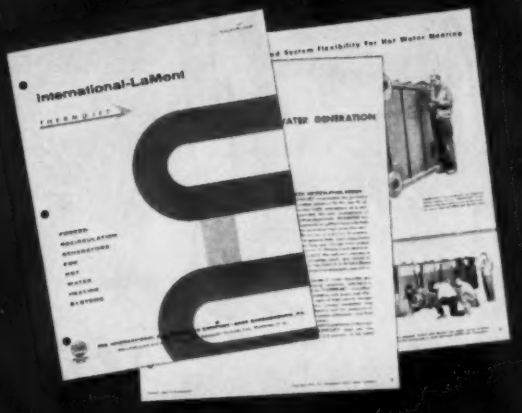

Useful information on the International-LaMont THERMOJET® for Hot Water Heating Systems.

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Continued from page 40

tem. Operating performance under varying conditions such as load, air flow, temperature, efficiency, gas consumption, etc. also can be measured. Rates of cooling water flow through the unit itself and through the mechanical induced draft type cooling tower may be observed continuously.

The installation will have three primary functions, according to Professor George M. Nixon, head of the mechanical engineering department of the University. First, it will permit students to conduct air conditioning experiments on a suitable plane. Second, it will make possible additional research and development in this field. And third, it makes available to industry the facilities and staff members of the University.

A research program to investigate utilization of the gas fired absorption air conditioner as a heat pump is also planned, Professor Nixon stated.

The department of mechanical engineering at the University of Bridgeport is currently engaged in establishing a laboratory to specialize in the study of air conditioning and refrigeration applications.

HPAC Contributing Editor Has Work Published In Japanese Paper

PART of the book, "Air Conditioning Analysis," by William Goodman, member of Heating, Piping & Air Conditioning's board of consulting and contributing editors, has been translated into Japanese in a Japanese publication. Much of the book's information appeared first in Heating, Piping & Air Conditioning before being compiled into book form.

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Weinman Types ACV and ADV Condensate Return Units are a wise investment in fast, trouble-free condensate return and overhead return of water or other liquids in gravity circulating systems.

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Weinman designs single pump models to meet standard requirements; duplex pump units for systems with heavy condensate loads and other liquid return or where a standby pump is needed. Both types handle liquids to 200° F. under hard, continuous service.

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Both units are available with either steel or cast iron receivers to meet specific requirements for handling different liquids.

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Either model converts to an efficient boiler feed unit by adding a solenoid-operated make-up valve.

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How To Balance an Air Distribution System

THE BASIC requirement for good air distribution is the selection and installation of proper equipment, according to Robert Guthrie, Barber-Colman Co. Mr. Guthrie discussed this topic at the recent Heating and Air Conditioning Engineering Institute at the University of Wisconsin.

Poor air distribution is commonly due to an omission in the design which prevents a clear understanding of what equipment is required. The contractor fails to recognize the intent and uses low quality equipment. This can be overcome, says Mr. Guthrie, by being explicit in describing the procedures to be followed in balancing air systems.

Specifications should spell out such things as who does the balancing, what is to be accomplished by the balancing procedure, and how the results are to be reported.

Who Does the Balancing?

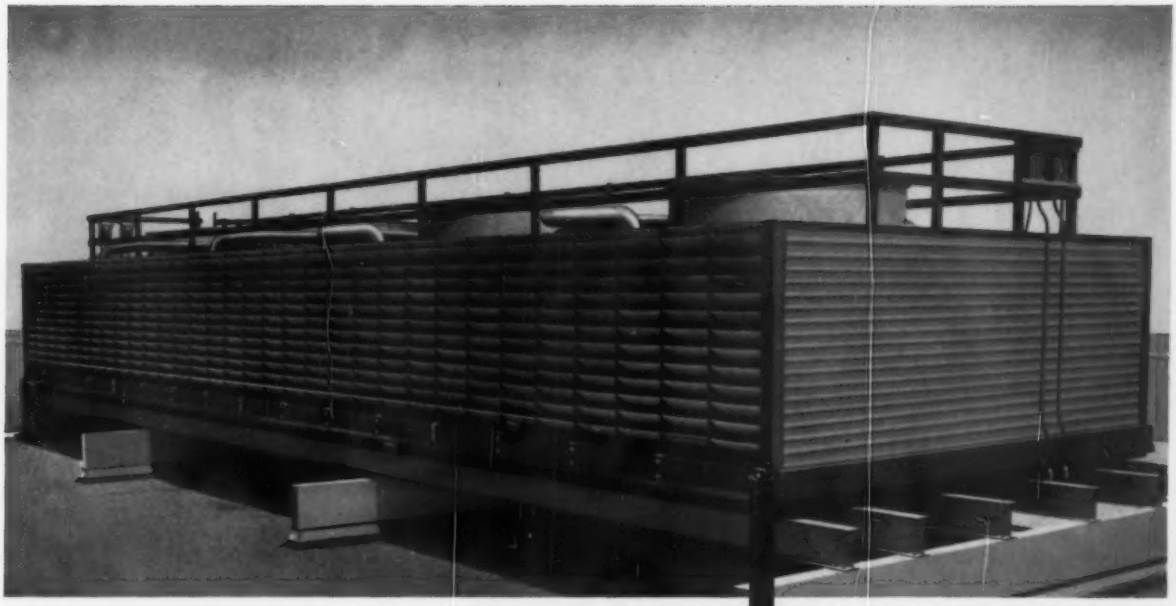
Various arrangements are used throughout the country with the responsibility shifting from one group or individual to another. These are:

1. Mechanical contractor, under supervision of consulting engineer or architect's respresentative.
2. Mechancial contractor, in cooperation with equipment manufacturer.
3. Equipment manufacturer.
4. Independent balancing organization (This is catching on in some areas, Mr. Guthrie said).
5. Technicians, under supervision of the consulting engineer.

What Is To Be Accomplished?

Proper air quantity of each out-

FLUOR COOLING TOWERS



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Says Otto Walters, Head Custodian, Capuchino High School, San Bruno, Calif.

Users, Engineers, Contractors—all agree:

"Everyone Benefits When It's an Enterprise"

The man who's on the job with heating operations day after day has the facts. At the modern, two-level Capuchino High School facility—which includes fifty-one class rooms, heated pool, gym, theater, auditorium, cafeteria, shops and kitchen—this man is Head Custodian Otto Walters. His four Enterprise Burners have delivered smooth, trouble-free service for both class rooms and hot water needs 5 days a week for nearly eight years.

On-the-job performance such as this naturally scores big with everyone down the line—dealer, engineer, contractor and user. Check the facts—you'll learn that the men who specify and work with Enterprise have found the best burner buy!

Fit your specifications to the *right* burner model from the complete range of Enterprise Burner sizes shown here:

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INPUT				OUTPUT		
Burner Size	Motor HP	Oil-GPH Max	Gas CF/HR	Steam LBS/HR	Steam BHP	Radiation-Sq. Ft. Steam
AA	½	4	600	464	13	1880
A	½	7	1050	812	23	3280
C	½	15	2250	1740	50	7050
E	½	20	3000	2320	67	9400
F	¾	30	4500	3480	100	14100
G	1	35	5250	4060	118	16400
H	1	50	7500	5800	168	23400
H	1½	60	9000	6960	201	28200
J	2	75	11250	8700	250	35250
K	3	100	15000	11600	336	46900
L	3	135	20250	15660	453	63400
M	5	200	30000	23200	672	94000

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ENTERPRISE

DEPENDABLE BURNERS

ADEL DIVISION, GENERAL METALS CORP. • 1444 WASHINGTON AVE., HUNTINGTON 1, W. VA.

you'll want to know

continued from page 200

let at manufacturer's rated sound level, at optimum fan operation is to be established.

How Are Results Reported?

Contractors should furnish a data sheet including the following information:

1. A list of measured air quantities.
2. Fan static pressure for all supply and return units. These should be related to the cfm and the fan curves.
3. The speeds of all fans.
4. The motor amperage draw during full load operation.

A check list was offered by Mr. Guthrie to assure avoidance of air distribution balancing problems. To be checked are:

1. Specifications, to see if they follow the beforementioned criteria.
2. Fan, is it controlled or running wild?
3. Are provisions made for balancing runouts?
4. Have necessary duct accessories been provided to facilitate final balancing (dampers, controlled dampers, etc.).
5. Have provisions been made for follow up? A check is necessary after the initial balancing to make sure that occupants do not adjust and throw system entirely out of balance. In some cases, men the contractor sends back to handle psychological balancing unbalance the system.

Mr. Guthrie expects to see more of the independent balancing services as systems become more complex. He said that these services are sometimes held responsible for, and paid for, all balancing during the first year of a system's life. Psychological adjustments made during the first year are recorded, and a final balance is checked and reported at the end of the year.

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completely self-contained air conditioning units

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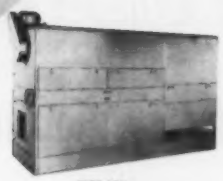
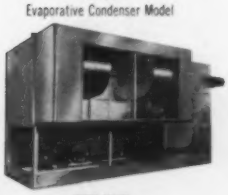
. . . began the manufacture of the first completely self-contained commercial type air conditioning units in 1937. Development has been continuous since that time, and Governair now manufactures packaged air conditioning units, for both commercial and industrial application, in the widest range of capacities available in the industry.

Governair Corporation also constantly recognizes the importance of producing a high quality, completely flexible system to benefit the end user best. Production facilities are tailored to accomplish these ends economically. This, in turn, makes the Governair prices highly competitive, even though only the finest components are used in the assembly.

Development of the larger tonnage units has made available the economy of installation and reliability of a factory balanced and tested package system . . . for even the largest industrial requirements. Single units of 120 ton capacity are being fabricated regularly — and to the exact specifications of the customer.

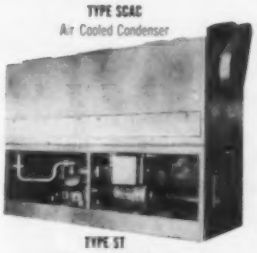


TYPE SCU
Evaporative Condenser Model



TYPE SCMZ
Complete Multi-Zone Package

TYPE SCAC
Air Cooled Condenser



TYPE ST
Water Cooled Model

TYPE STMZ
Water Cooled Multi-Zone

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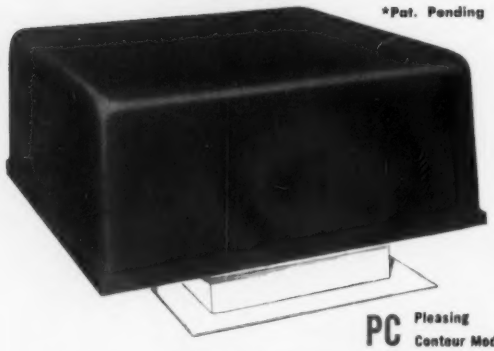

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Construction Contracts Set Record for Year

AN ENORMOUS volume of construction contracts awarded in December pushed the total for 1960 to a new all-time high for the United States, F. W. Dodge Corp. reported recently.

Leading the way in gains were heavy engineering and non-residential construction. Heavy engineering was up 92 percent over the same month in 1959. Non residential construction increased 26 percent. Totals for the year saw heavy engineering up 16 percent and non-residential up 7 percent. Residential construction suffered a 12 percent decrease for both December and the yearly total.

Total construction contracts for the year amounted to $36,317,629,000, slightly ahead of the previous record set in 1959. It was the 14th year in a row in which the record has been broken. The December figure was not only the largest for any December, but on a seasonally adjusted basis, it was the highest peak reported for any month. The Dodge index reached a record of 302 (1947-1949 = 100).

Roof-Mounted Air Conditioners Cool, Heat Computer Plant

A MODEL electronic computer plant in Palm Beach Gardens, Fla. is heated and cooled by 58 roof-mounted unitary air conditioners which supply a total capacity of 1000 tons of cooling. Composed of five buildings, the facility is owned by the Radio Corp. of America.

Among the design problems of the heating and cooling system encountered by architect Malcolm E. Wells and consulting engineers Arthur Parker Associates was the need for flexibility and attractiveness. Roof-mounted units were selected because of their speed of installation and ease of future expansion, according to Air Conditioning, Inc. They were supplied in low-silhouette models and painted dark beige to conform to the general architectural and color scheme.

"Open for Discussion"

Continued from page 80

Adds Further Comments on Chemical, Mechanical Means to Boiler Protection

I WOULD LIKE to comment on the suggestions in the February issue by J. P. Prosser of the Raytheon Co., on my answer to the question, *How Can We Protect Boilers' Internal Metal Surfaces?* in the November 1960 issue.

At the outset I should note that my recommendations related solely to heating boiler systems. I am in agreement with Mr. Prosser that deaeration of feed water is essential to the successful operation of high pressure boilers when dissolved oxygen is a problem in the make-up or the condensate return.

In my opinion, the question of protecting against water side corrosion in heating boilers is one of economics. The use of an effective deaerator will control oxygen corrosion by mechanical means which eliminate the cause. The practices suggested in my answer to this question in the November 1960 issue will control oxygen corrosion by chemical means which inhibit such corrosion even when oxygen is present in concentration as high as 6 milliliters.

The chemical treatment will cost a few dollars per year for each 10,000 sq ft of installed radiation. I do not know how much it would cost to install and operate a deaerator. That device would need the capacity to deaerate about 3000 lb of water per hr for each 10,000 sq ft of installed radiation.

Mr. Prosser has stated that chemical compounds designed for protecting against oxygen corrosion may form protective coatings on the internal surfaces and thereby impede heat transfer by a small amount. It is true that some chemical boiler water treatments may coat the heating surfaces of boilers in which they are used. Usually these treatments are those which are introduced frequently, often daily. The treatment which I suggested is one of the so-called "one-shot" treatments which are introduced only at the time when boilers are refilled after draining, usually once per heating season. To the best of my knowledge and belief, this inhibitor does not coat the heating surfaces nor otherwise interfere with the heat transfer rate in boilers.

I am glad that Mr. Prosser has called attention to the fact that oxygen corrosion in boilers may be controlled by the use of deaerators in the makeup and condensate return lines. His comments will serve to bring this subject to the attention of engineers who design steam heating systems.

JOHN W. TURNER
Consulting Engineer

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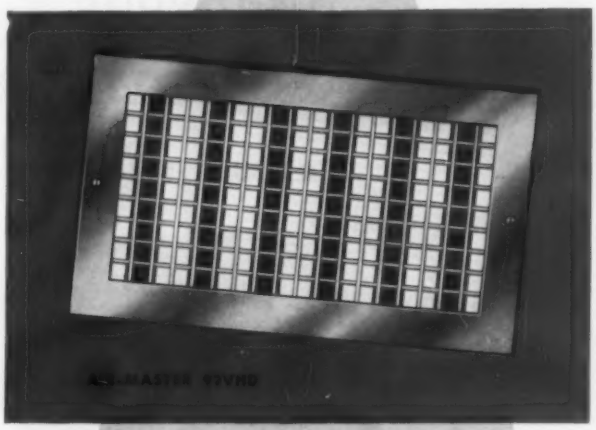

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6527 CLINTON ROAD . . . CLEVELAND 9, OHIO

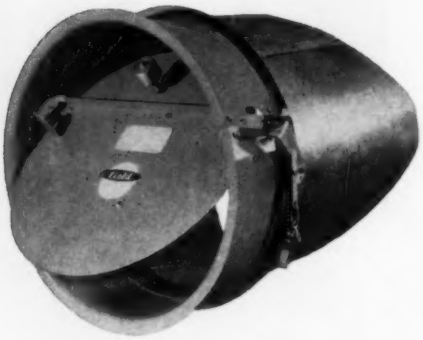
Don't design a

DRAFT SHORTAGE

into your

GAS BOILER

installations



Specify a double-acting

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DRAFT CONTROL*

*With a Field the draft assistance of the chimney becomes available to the boiler for abundant draft at all firing rates, precisely controlled to the optimum twelve-to-one air-to-gas ratio recommended for clean, bright, efficient combustion. For 5" through 34" flue outlets. Write for specification data.

Specify Field Draft Controls for gas, gas-oil, oil or coal, for boilers, furnaces, incinerators, with natural, forced or induced draft, 5" through 34" flues.

FIELD CONTROL DIVISION

Conco Engineering Works, Inc., Mendota, Illinois

AFFILIATES: **Spartan Tool Division — Powered Sewer Cleaning Equipment**
Materials Handling Division — Cranes, Hoists
Conco Building Products, Inc. — Brick, Tile, Stone

RECENT TRADE LITERATURE . . .

▸ *AIR CONDITIONER, FAN-COIL-FILTER*—two page bulletin describes assembly available as a basic unit, as concealed cabinet, or deluxe cabinet for either DX or water. Basic construction and performance data charted in graph form, listing nominal ratings for 13-model line. Cfm range listed at 500 to 1750 in one-fan, and two-fan units. *Drayer-Hanson Div., Hi-Press Air Conditioning of America, Inc.*, 3301 *Medford St., Los Angeles* 63.

▸ *BURNERS, ATMOSPHERIC, GAS-FIRED*—14 page Bulletin No. H-1 describes eight units with maximum firing capacities from 10,000 to 2,750,000 Btu per hr. Gives dimensions, specifications, and engineering data for pipe, immersion, ring, box, and "U" type burners, atmospheric injectors, and packaged burners. Gives introduction to operating principle of atmospheric burners and illustrates six typical installations. *Combustion Div., Eclipse Fuel Engineering Co., Rockford, Ill.*

▸ *CONTROLS, FREQUENCY RESPONSE OF*—12 page Bulletin TM-6 gives fundamental knowledge of the terminology and a basic understanding of this control field technique. *Fisher Governor Co., P.O. Box* 307, *Marshalltown, Ia.*

▸ *CONTROL SYSTEMS, COMBUSTION*—32 page Bulletin 1001 gives analysis of proportioning and metering combustion control systems. Describes operation and mounting procedures, and illustrates with block-diagrams. Typical applications given, proceeding from basic to complex systems. *Reliance Instrument Div., Electro-Mech Corp., Norwood, N.J.*

▸ *DRIVES, ADJUSTABLE SPEED*—six page Bulletin 2900 describes four types of complete package ad-

MSA reports on:

How to Select an Air Cleaner

MSA reviews here some of the factors which influence selection of air cleaners. A speaking acquaintance with these factors can save a lot of time and money. If you would like to dwell further on any of these points, please drop us a line. We believe we can be of great help in answering questions on your specific air cleaning problems.

CLASSIFICATION OF PARTICULATE LOADS—Let's draw a parallel. Because of the heavy dust load in a sand blast booth, you would have to select a sand blast mask instead of a dust respirator. Selection of a particulate space filter is much the same proposition. You must determine the quantitative nature of the particulate load.

For this purpose, let's briefly classify particulate loads. A light load is 0.1 to 1 grain per 1000 cu. ft. A medium load is 1 to 1000 grains per 1000 cu. ft. A heavy load is 1000 grains and up per 1000 cu. ft.

One grain per 1000 cu. ft. = 2.3 mg per cubic meter = 2.3 micrograms per liter. One milligram is equivalent to 0.015432 grains. As a comparison, the concentration of the U. S. Bureau of Mines silica dust test is approximately 22 grains per 1000 cu. ft. of air.

CLASSIFICATION OF NORMAL LOAD RANGES—Country air usually registers 0.2 grains/1000 CF. Small town air ranges from 0.2 to 0.4 grains/1000 CF. City residential air ranges from 0.4 to 0.8 grains/1000 CF. City industrial air ranges from 1.0 to 2.0 grains/1000 CF. And air from industrial operations weighs in at 4.0 to 8.0 grains/1000 CF. 7000 grains, incidentally, is equal to 1 lb.

CLASSIFICATION OF PARTICULATE CLEANERS—Your actual load condition will determine which group of particulate cleaners is of immediate interest to you.

For the heavy loads: gravity separators, cyclone separators and sonic collectors.

For the medium loads: all of the above plus bag filters, impingement type box filters, and wet collectors.

For the light loads: box filters of both types and, in addition, electrostatic precipitators.

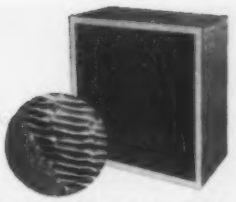
Of course, if you require ultra filtration on heavy load conditions, you should use M-S-A® UltraAire* Space Filters after the heavy duty filters.

PHYSICAL CHARACTERISTICS OF THE PARTICULATES—These characteristics affect the choice of filtering methods and/or design of the filtering system: Particle size, particle shape, specific gravity of particles, particle surface characteristics, packing or plugging characteristics, electrostatic charge on the particle, stability of the particle.

PHYSICAL CHARACTERISTICS OF THE AIR STREAM—These factors too, are worthy of investigation: Density of air, moisture in air stream, temperature of air stream, chemical and physical effect of gaseous contaminants.

DEGREE OF FILTERING OR CLEANLINESS REQUIRED—We'd like to suggest here, that you give some thought to the toxicity or harmfulness of the particulate matter. Evaluate too, the need for cleanliness, product control, equipment maintenance, etc.

ECONOMIC FACTORS—Factors to weigh under this heading are installation costs, space requirements and operating and maintenance costs (including cost of moving air through system, replacement, etc.).

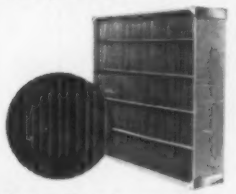


M-S-A® UltraAire* Space Filter

Lightweight, fire-resistant, unusually strong, and ideal for high humidity service. Individually pre-tested and proved at least 99.97% efficient in removing particles of 0.3 micron diameter.

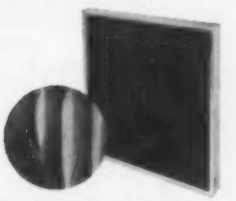
M-S-A® Cylindrical-Type UltraAire* Space Filter

Honeycomb-type fold without separators is admirably suited to cylindrical element construction. This shape is preferred for pressure systems and round ducts. Easy to handle. Inexpensive to ship.



M-S-A® Dustfoe* Space Filter

Offers the efficiency of an Electrostatic Precipitator without the high cost and without the possibility of arcing "blow-off." 85-95% certified efficiency on NBS Atmospheric Air Dust Stain Rating.



M-S-A® Air-O-Kay* PreFilter

Impingement type panel prefilter which can be used oiled or dry to remove lint and other large airborne particles from the atmosphere. 60-70% certified efficiency on NBS Stain Rating.

Write for illustrated technical bulletins on M-S-A Space Filters related to your particular system problem. Ask an MSA Representative for system recommendations.

Fluid Purification Specialists for 45 Years

MINE SAFETY APPLIANCES COMPANY

201 North Braddock Avenue, Pittsburgh 8, Pa.

MSA*

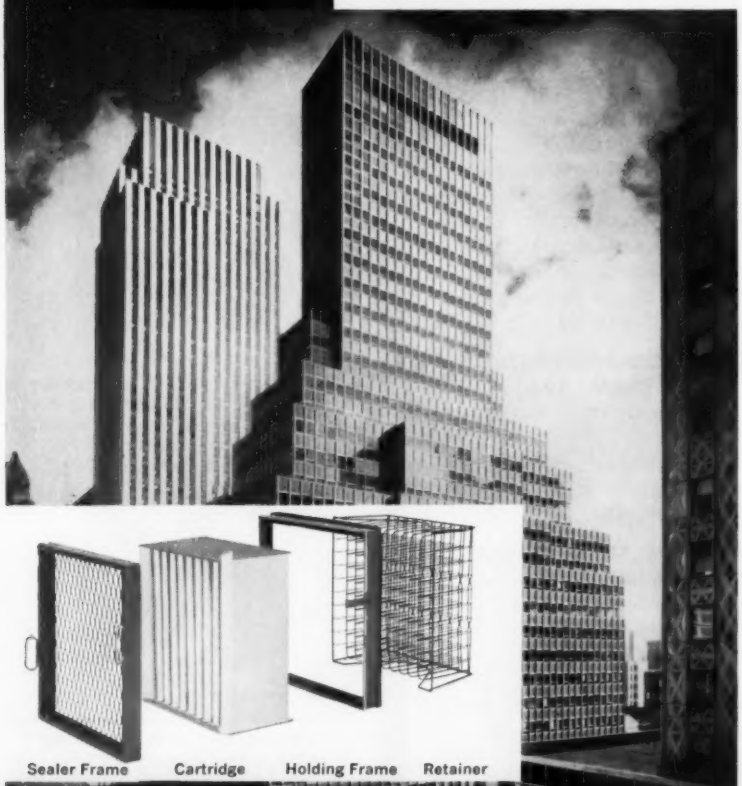
*Trademark

Other Fluid Purification Equipment includes catalytic filters for jet aircraft cabin air; air separation plants; inert gas generators; space capsules; bomb shelters; air line filters; jet fuel and hydraulic fluid purification.

The Lorillard Building's Ventilating System is filtered through **FARR HP** air filters

Standing 30 stories tall on the corner of Third Avenue and East 42nd Street, the Lorillard Building is a "tower of transparent glass." With almost 300,000 square feet of office space, it is the home of several famous American companies as well as housing the United Nations missions of Finland, Colombia and other delegations. The entire building is air conditioned and the system pours 321,000 CFM through banks of Farr HP disposable filters.

HP Filters are (1) **deep-pleated** for greater dirt-holding capacity and longer service life. (2) Their **light weight** makes them simple to install and replace. (3) They come **folded**, 5 and 10 to a case, for ease of shipping and storing. (4) They are **flameproof**. Choice of three filter cartridges—ranging from 35% to 95% efficiency.



LORILLARD BUILDING
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Owners & Builders:
The Durst Organization
Consulting Engineer:
Rutherford L. Stinard
General Contractor:
Diesel Construction Co., Inc.

FOR FURTHER INFORMATION, WRITE TO
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AIRPORT STATION, LOS ANGELES 45, CALIF.

RECENT TRADE LITERATURE
Continued

justable speed drives for ¾ to 2500 hp application. Gives details on available ratings, speed ranges, type enclosures, associated controls, and many standard and special modifications. *The Louis Allis Co., 427 E. Stewart St., Milwaukee* 1.

▸ *FABRICS, INDUSTRIAL COATED*—12 page catalog describes physical properties, performance characteristics, and applications of more than 200 different styles of fabrics. Fabrics available include cotton, nylon, "Orlon," "Dacron," silk, fiber glass, and blends. Among the principle coatings are "Buna-N," "Neoprene," natural rubber, and special purpose elastomers. Applications include flexible tubing, gaskets, vapor barriers, ventilation tubing, and other uses. *Vulcan Div., Reeves Brothers, Inc.*, 1071 *Ave. of the Americas, New York* 18.

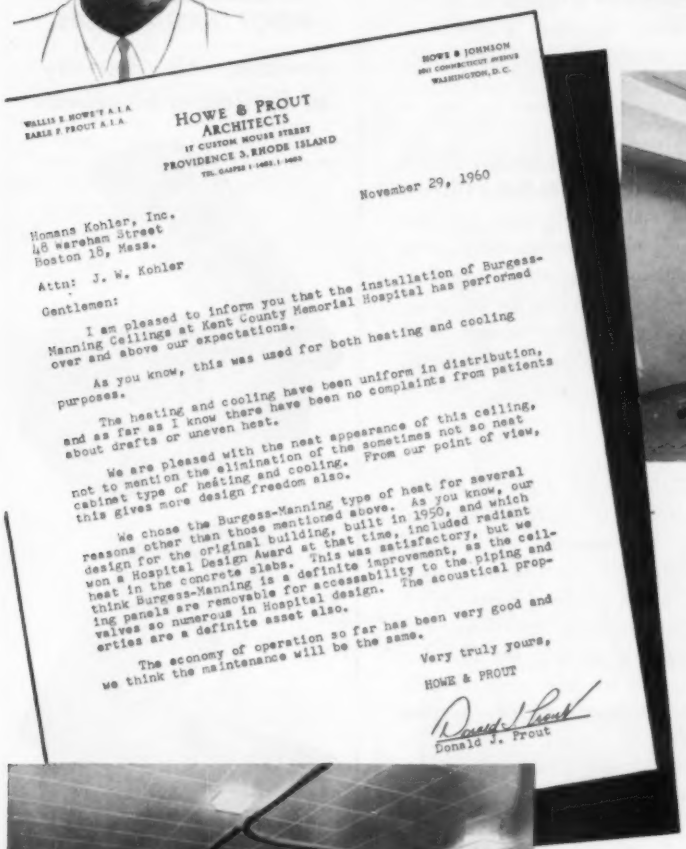
▸ *FANS, VENTILATING*—four page bulletin 1160 describes direct drive packaged units with no belts. Contains dimensions and performance charts on seven sizes of fan. Three types of weather-sealed wall shutters, and sketch of typical installation included. *Modine Manufacturing Co.*, 1500 *DeKoven Ave., Racine, Wis.*

▸ *FILTERS, AIR, FOR ELECTRONIC EQUIPMENT*—eight page Bulletin B-100-6 contains detailed charts, tables, and other engineering data needed to size and select air filters both for electronic equipment and for the room or mobile equipment that contains it. Data on filter media, shapes, and mounting methods included. Special filter applications described, along with finishes, uses, and maintenance methods. *Farr Co., P.O. Box* 90187, *Airport Station, Los Angeles* 45.

▸ *FILTERS, AIR, PANEL*—four page Bulletin A1 describes "ULOK"

"From our point of view. . . .
the Burgess-Manning Radiant Ceiling
gives more design freedom"

. . . Donald J. Prout, Architect



WALLIS R. HOWE F.A.I.A.
EARLE P. PROUT A.I.A.

HOWE & PROUT
ARCHITECTS
17 CUSTOM HOUSE STREET
PROVIDENCE 3, RHODE ISLAND
TEL. GASPEE 1-1402, 1-1403

HOWE & JOHNSON
1001 CONNECTICUT AVENUE
WASHINGTON, D.C.

November 29, 1960

Homans Kohler, Inc.
48 Wareham Street
Boston 18, Mass.

Attn: J. W. Kohler

Gentlemen:

I am pleased to inform you that the installation of Burgess-Manning Ceilings at Kent County Memorial Hospital has performed over and above our expectations.

As you know, this was used for both heating and cooling purposes.

The heating and cooling have been uniform in distribution, and as far as I know there have been no complaints from patients about drafts or uneven heat.

We are pleased with the neat appearance of this ceiling, not to mention the elimination of the sometimes not so neat cabinet type of heating and cooling. From our point of view, this gives more design freedom also.

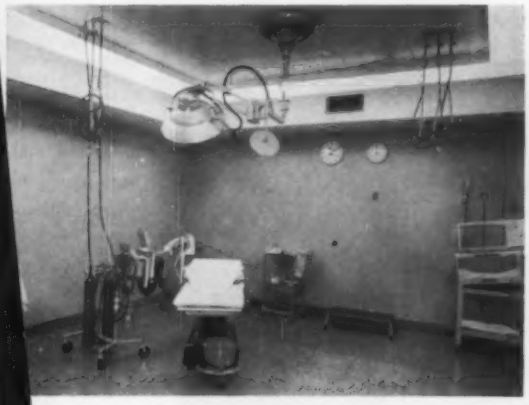
We chose the Burgess-Manning type of heat for several reasons other than those mentioned above. As you know, our design for the original building, built in 1950, and which won a Hospital Design Award at that time, included radiant heat in the concrete slabs. This was satisfactory, but we think Burgess-Manning is a definite improvement, as the ceiling panels are removable for accessability to the piping and valves so numerous in Hospital design. The acoustical properties are a definite asset also.

The economy of operation so far has been very good and we think the maintenance will be the same.

Very truly yours,

HOWE & PROUT

Donald J. Prout



Mr. Prout's letter confirms the fact that no other radiant acoustical ceiling has the structural flexibility possible with the Burgess-Manning Radiant Heating, Cooling and Acoustic Ceiling. It is this unusual design flexibility—unhampered by compromises in radiant, mechanical or structural design—which permits suitable ceiling layout to any module.

Of extreme interest, also, is the performance of the Burgess-Manning Radiant Acoustical Ceiling in buildings where there is a considerable amount of glass area—as at the Kent County Memorial Hospital, particularly in the solariums and lobby. Even with the front of the hospital having a southern exposure presenting difficult air conditioning as well as zoning problems, the Burgess-Manning Radiant Acoustical Ceiling, Mr. Prout points out, "performed over and above our expectations."

While the original design included floor-by-floor cooling . . . today, just the first and third floors (operating suite) are completely cooled by Burgess-Manning Radiant Cooling. Only chilled water equipment will be required for cooling the other floors at a later date.

Hospitals and institutions across the country report complete and lasting satisfaction with the Burgess-Manning Radiant Acoustical Ceiling. You, too, can secure the many distinct and profitable design advances . . . with *your budget no bigger* . . . offered by the Burgess-Manning Radiant Acoustical Ceiling for hospitals. Send for the complete story—Bulletin 138-3G.

Burgess-Manning Ceiling Area—40,600 sq. ft.
Architect — Donald J. Prout & Associates
(formerly Howe & Prout)
Engineer — A. Ehrenzeller, Inc.
Ceiling Contractor — Pitcher & Company

3 Heating Cooling Acoustic

BURGESS-MANNING COMPANY
Architectural Products Division
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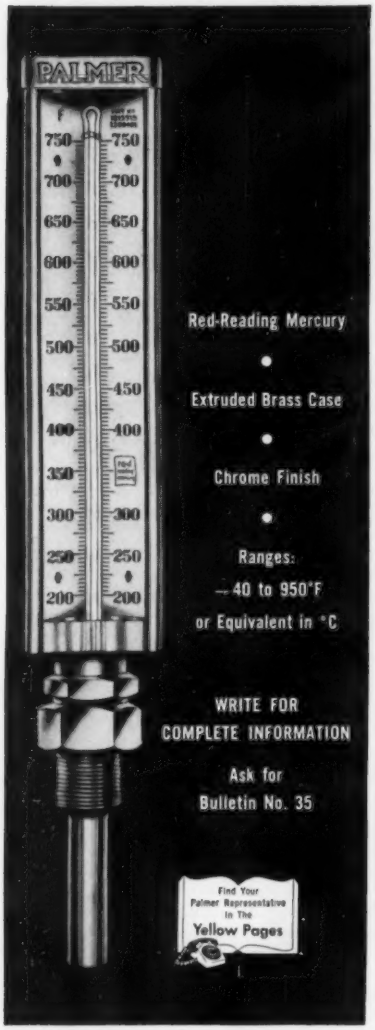
TODAY'S MODERN INDUSTRY
DEMANDS A MODERN THERMOMETER

PALMER

RED-READING MERCURY THERMOMETERS



PALMER

PALMER THERMOMETERS, INC.

Mfrs. of Industrial Laboratory, Recording
and Dial Thermometers • Cincinnati 12, Ohio

RECENT TRADE LITERATURE
Continued

throw-away type 1 and 2 in. thick filters in nine sizes. Dynel filter material has irregular cross-section. Performance graphs and diagrams of typical arrangements included. *Union Carbide Development Co.*, 270 *Park Ave., New York* 17.

▸ *HEATERS, INFRARED ELECTRIC*—eight page Bulletin CH-100 describes quartz lamp units used for indoor or outdoor service. Gives principles, advantages, typical applications, electrical specifications, radiation distribution patterns, and other technical information. *Fostoria Corp.*, 1200 *N. Main St., Dept.* 87, *Fostoria, O.*

▸ *HEATING AND VENTILATING SYSTEMS FOR SCHOOLS*—manual gives presentation of technical advantages and installation procedure of firm's gas-fired units. Available to consulting engineers and mechanical contractors for distribution to school administrative officials, school board members, etc. *Norman Products Co., Div. of John J. Nesbitt, Inc.*, 1150 *Chesapeake Ave., Columbus* 12, *O.*

▸ *INSULATION EFFICIENCY COST REPORT*—four page catalog report shows a cost comparison on insulations used for an underground heat distribution system. Calculations based on National District Heating Association's method of measuring heat loss. *Ric-wiL, Inc., Barberton, O.*

▸ *JOINTS, ROTARY*—four page Catalog 310B describes units for single or syphon flow, steam, water, air, oil, or gas service to temperatures of 600 F. Eight sizes from ½ through 3 in. with flanged connections or right or left-hand threads on the rotating sleeve. Gives typical installation diagram and instructions for installation. Lists dimensions and pressure ratings. *Barco Manufacturing Co., Dept. RJ-42*, 500 *Hough St., Barrington, Ill.*

AirMaster

LO-BOY
CENTRIFUGAL
ROOF EXHAUSTERS

Enhance the Beauty of Building Skylines

Pats. Pend.

Lowest Silhouette Design

Forward or Backward Curve Wheel Within . . . . or Out of Scroll Housing

Motor mounting on side of structure support . . . out of line of air stream reduces height of Lo-Boy models nearly 50% of older designs.

LOW WIND RESISTANCE
SIZES 10"-72" 600-47,000
CERTIFIED C.F.M. RATINGS

● QUALITY ● BEAUTY
● PROVEN PERFORMANCE

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AMMERMAN CO., INC.

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MEMBER OF THE AIR MOVING & CONDITIONING ASSN.

Keflex Manufacturing Division
U. S. Flexible Metallic Tubing Co.
Since 1905

KEFLEX

LAMINATED
STAINLESS STEEL BELLOWS
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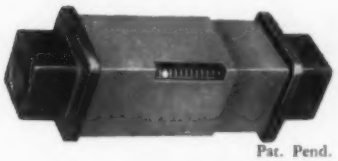
KEFLEX QUADRA-SIDE EXPANSION COMPENSATORS

FOR STEAM AND HOT WATER HEATING SYSTEMS
USED WITH CONVECTOR AND FIN TUBE BASEBOARD RADIATION UNITS
IN SCHOOLS, HOSPITALS, OFFICES AND COMMERCIAL INSTALLATIONS

TYPE 7 Q square brass telescoping case protects laminated stainless steel bellows from torsion, squirm, misalignment and external damage. Compensators are used in high and low pressure hot water supply lines, risers and for baseboard radiation. Extra flexibility provides maximum cyclic life. Units are very compact and rugged. Sizes ¾" thru 3". Pressures to 300 PSI. Temperatures to 800°F. Traverse: Single Units, total 2" (1-½" compression, ½" extension) Dual units available.

TYPE 11 Q-T has heavy square telescoping case and laminated stainless steel bellows. For use in risers and with baseboard radiation. Test pressure 150 PSI, working pressure 100 PSI, temperatures to 300°F. Traverse: Total 1" (¾" compression, ¼" extension).

TYPE 7 Q WITH BRASS FEMALE THREADED ENDS
Working Pres. 300 PSI Maximum
Temp. 800 F



Pat. Pend.

Nom. I.P.S.	Overall Length	Max. O.D.	Wt. #
¼"-1.00"-1.25"	6.50"	2.00"	2
1.50	6.50	2.50	4
2.00	6.50	3.00	5
2.50	6.50	3.50	6
3.00	6.50	4.00	9

TYPE 7 Q-T WITH COPPER TUBE ENDS
Maximum Pres. 200 PSI Maximum
Temp. 300 F

Pat. Pend.

To Fit Copper Tubing		Overall Length	Max. O.D.	Wt. #
Nominal I.D.	Actual O.D.			
¾"	⅞"	6.50"	2.00"	1½
1	1⅛	6.50	2.00	1½
1¼	1⅜	6.50	2.00	1½
1½	1⅝	9.00	2.50	3½
2	2⅛	10.00	3.00	4½
2½	2⅝	10.75	3.50	5½
3	3⅛	11.50	4.00	8¼

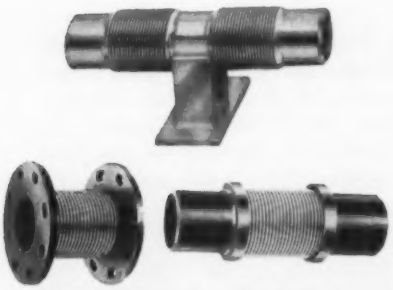
TYPE 11 Q-T WITH COPPER TUBE ENDS
Maximum Pres. 100 PSI Maximum
Temp. 300 F

Pat. Pend.

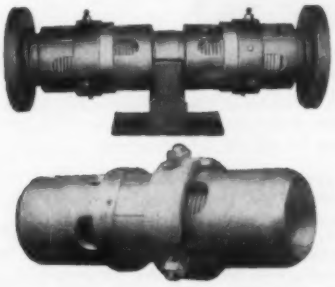
To Fit Copper Tubing		Overall Length	Max. O.D.	Wt. #
Normal I.D.	Actual O.D.			
¾"	⅞"	4.50"	1.50"	1¼
1	1⅛	4.50	1.50	1¼
1¼	1⅜	4.50	1.75	1½
1½	1⅝	4.50	2.25	3
2	2⅛	4.50	2.75	4

EXPANSION JOINTS—VIBRATION ABSORBERS—FLEXIBLE CONNECTORS—PIPE GUIDES

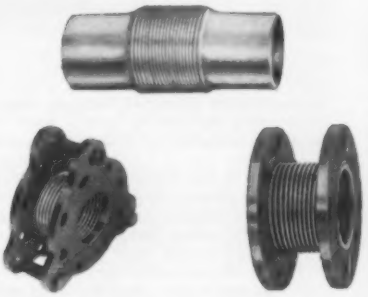
Force Required to Compress Keflex Expansion Joints Their Full Rated Traverse is Usually Less Than 100 Lbs., Total



KEFLEX EXPANSION JOINTS — corrugated, packless type for steam and hot water heating systems and process piping. Laminated stainless steel bellows with internal liner guides and stainless steel contour control rings. Weld ends, or flanges. Outside shrouds and intermediate anchor bases available. Sizes 2" through 48". Pressures 70 to 450 PSI. Temperatures to 800° F. Furnished for various required traverses.

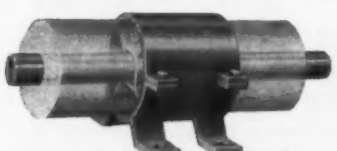


KEFLEX-KETROL CONTROLLED EXPANSION JOINTS — positive protection against torsion. For use in pipe lines to compensate for expansion and contraction. Shroud has intermeshing fingers providing concentric guiding and protection against squirm, torsion, and external damage to laminated stainless steel bellows. Designed for high pressure, high temperature hot water service. Movement is controlled by limit stops. Sizes 2" through 48". Pressures to 450 PSI and temperatures to 800° F.



KEFLEX FLEXIBLE CONNECTORS AND VIBRATION ABSORBERS — to absorb vibration from pumps, chillers, and compressors. Serves to relieve stress on pump volute when piping is misaligned. Extra flexibility of laminated stainless steel construction produces long cyclic life. Compact units save space and are easy to install. Available with or without tie rods. Sizes 2" through 48". Pressures to 450 PSI and temperatures to 800° F.

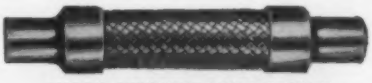
Modified Types are available for special conditions requiring higher pressure, temperatures, traverse, or combination deflections.



KEFLEX-MAVE TYPE M

Fabricated steel pipe guides for concentric guiding of pipe lines. Special insulated guides are available for chilled water.

FLEXIBLE "BMH" CONNECTORS



"USF" BRONZE VIBRATION ABSORBERS

Braided bronze Metal Hose assemblies made in standard lengths. Usually used as flexible connectors on pumps and other mechanical equipment for heating and air conditioning service. Available with threaded male ends, flanges, and copper tube sweat ends.

SPECIFY General RUBBER

Custom-Made

FLEXIBLE RUBBER EXPANSION JOINTS AND PIPE for your WATER · BRINE · GAS CHEMICAL · PIPE LINES

- Absorb Vibration, Noise and Water Hammer
- Prevent Expansion-Contraction Stresses
- Compensate for Minor Misalignment
- Stop Galvanic Action

RUGGED, LONG LIFE

FLEXIBLE FLANGED RUBBER PIPE

General Rubber offers two complete time-tested lines of full-faced, flanged rubber pipe for air conditioning and heating systems. Both lines are made in standard pipe sizes from 1" to 12" for either 150 p.s.i.g. or 250 p.s.i.g. pressure service or for 30" Hg vacuum service.

Type F Full-Faced Flanged Rubber Pipe. General Rubber's Type F flexible rubber pipe is made with full-faced, integral rubber flanges. Installed with our galvanized steel split retaining rings, the resilient rubber flanges form a tight seal against the pipe flange without the need of gaskets. Bulletin 580.

SoundZorber® Wire-Reinforced Rubber Pipe. The rugged heavy-duty SoundZorber pipe repays its cost many times over. Its unique solid molded rubber flanges, with built-in steel flanges, will operate under the most adverse conditions. Bulletin No. 866.

Type GRC Rubber Expansion Joints. Long life, custom-made Type GRC Expansion Joints are available for pressures up to 150 p.s.i.g., in sizes from 1" to 72" I.D. Flexing action keeps rubber "alive," free from embrittlement and scale formation. Particularly valuable in systems handling corrosive and abrasive chemicals. Catalog No. 888.

OTHER GRC FLEXIBLE UNITS

- Screwed coupling Type S flexible pipe in standard pipe sizes from ¾" to 3". Bulletin No. 580.
- New Type G, Gen-Lok reinforced flanged flexible pipe for fast, perfect bolt hole alignment. Bulletin No. 580.

General RUBBER CORPORATION

50 SUMMIT STREET · TENAFLY, N. J.

TELEPHONES: N. Y. – OXford 5-0328 · N. J. – LOwell 7-0222

TECHNICAL SERVICE GRC IN RUBBER

RECENT TRADE LITERATURE

Continued

▸ *METALS*—16 page directory gives information on aluminum, brass, bronze, copper, nickel, silver, rhenium, stainless steel, and zirconium. Product literature, films, and other information included. *Chase Brass & Copper Co., Waterbury* 20, *Conn.*

▸ *MODULES, ELECTRONIC TIMING*—five page Bulletin PD-1016 includes dimensional drawings, table of characteristics, and complete specifications for types "406-1, 406-2, and 406-3," covering time delays from 0.1 to 60 seconds. *GV Controls Inc.*, 101 *Okner Parkway, Livingston, N.J.*

▸ *MOTOR, FRACTIONAL HP*—eight page Bulletin B-2514 gives construction and design information of "Duty Master FHP." Compact magnetic electrical parts for size and weight reduction. *Reliance Electric and Engineering Co., Cleveland* 17.

▸ *MOTORS, ELECTRIC*—eight page Bulletin 2651 outlines 23 types of motors including standard squirrel cage units from ¼ to 2500 hp, open, enclosed, explosion and weather protected enclosures; gearmotors to 150 hp; d-c motors to 400 hp; and other type units. Application data given along with ratings, enclosures, and modifications. *The Louis Allis Co.*, 427 *E. Stewart St., Milwaukee* 1.

▸ *NEGATIVE ION GENERATORS*—booklet CE 860 tells how to build negative ion generators and how to measure their output. *Westinghouse Lamp Div., Westinghouse Electric Corp., MacArthur Ave., Bloomfield, N.J.*

▸ *PIPE, FLANGE, FITTING DATA*—10 in. slide card gives pipe, flange, and fitting information. Includes tables on pipe sizes, schedule number, wall thickness, weight per ft, and

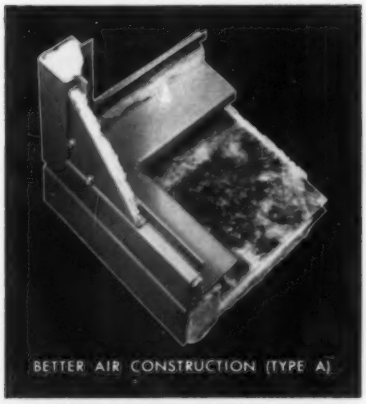
Why Kennard/Nelson's 2-line idea is important to you!

NOW *any* air conditioning system you design—regardless of whether quality or cost comes first—can include reliable performance and complete air engineering service from Kennard/Nelson*. Kennard/Nelson is the first manufacturer to introduce *two lines* of packaged central station air conditioning equipment . . . and the first to offer you a choice for clients who want higher quality without using expensive custom construction.

One line of air conditioning equipment is designed to "meet or exceed" industry standards. But the other line—the Kennard/Nelson "Better Air" line—offers you life-of-the-building construction and unmatched operating economy. Here are a few reasons why a *Better Air* unit will "pay its own way" in your system:

1 "Better Air" line introduces life-of-the-building design for air conditioning systems!

• **PENTA-POST FRAMES.** Only Kennard/Nelson *Better Air* units offer rugged Penta-Post frame construction. These heavy-gauge steel frames feature solid 5-angle, all-welded construction. *Better Air* frame design adds years to unit life and holds maintenance costs to a minimum.



BETTER AIR CONSTRUCTION (TYPE A)

• **DOUBLE DRAIN PANS.** Two separate drain pans, divided by a one-inch pad of insulation, cut replacement costs. Pans slope for more efficient drainage, and inner pans are available in long-lasting galvanized, copper, or other metals.

• **FLUSH-MOUNTED DESIGN.** Every component on *Better Air* units is made easily accessible through flush-mounted service panels with quick-opening doors. Handy exterior access handles make service faster and more convenient.

• **CLASS I FANS.** Every Kennard/Nelson air conditioning unit is equipped with high-efficiency Class I fans. Forwardly curved fan design is standard equipment although backwardly inclined fans are available.

Factory-engineered "built-in" air cleaning allows engineers to specify the exact type and degree of air cleaning desired on *all* models in the *Better Air* line.

2 "Standard" line offers many better air features, wide range of sizes!

On the other hand, the Kennard/Nelson "Standard" line, offered with many "Better Air" features, is designed for those installations where *cost* is the primary concern. Class I fans are also included on all Kennard/Nelson "Standard" units. Standard units are equipped with the same efficient hydraulically-expanded, non-ferrous plate fin coils as are used in "Better Air" units.

STANDARD UNIT CONSTRUCTION (TYPE D)

Both Kennard/Nelson lines are available in a wide range of sizes and arrangements. There are 14 basic sizes and 24 different arrangements (500 cfm to 36,000 cfm) in the "Better Air" line alone.

Discuss the merits of *both* lines with your Kennard/Nelson representative. Ask him for the new bulletin covering each line or write for Bulletins No. AC-100 (Better Air Line) and No. D-100 (Standard Line): American Air Filter Company, Inc., 373 Central Avenue, Louisville 8, Kentucky.

**Herman Nelson and Kennard, for years familiar names in the heating, ventilating, and air conditioning industry, have been combined as a single division of the American Air Filter Company, Inc.*

AAF American Air Filter
BETTER AIR IS OUR BUSINESS

METERING LIQUIDS

with

WIDE FLOW VARIATIONS?

For

Lasting Accuracy and Dependability choose a

CADILLAC

Integrating Type

LIQUID METER

7 Sizes
Capacities:
1/2 GPM to 25 GPM

For all Non-Viscous Non-Volatile Liquids

Requires only 4-18 inches of water head to operate.

Accurate to within 1% from zero to rated capacity.

Simple design gives long useful life, with practically no servicing.

• • • •

Write for new catalog and name of your nearest distributor.

CENTRAL STATION STEAM CO.
2912 E. Woodbridge • Detroit 7, Mich.

RECENT TRADE LITERATURE

Continued

pressure at yield on pipe from 1/8 to 24 in. Also includes welded flanges and fittings, size 2 to 30 in., dimensions and weight per piece. *Albert Pipe Supply Co., Inc.*, 101 *Varick Ave., Brooklyn* 37.

▸ *PIPE, POLYETHYLENE*—eight page bulletin describes quality, type, density, and proper application of polyethylene pipe. Includes tables, comparisons, and gives installation instructions. *Union Carbide Plastics Co., Div. of Union Carbide Corp.*, 270 *Park Ave., New York* 17.

▸ *PSYCHROMETRIC CHART*—for use in the selection of air conditioning equipment. Based on data published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers. Chart in three colors. *The Trane Co., La Crosse, Wis.*

▸ *PUMP SEALS*—revised Catalog No. 460 lists over 250 pump seals. Includes illustrations, dimensions, and technical data. *U. S. Seal Manufacturing Corp., Dept. PR-2*, 60 *Lispenard St., New York* 13.

▸ *PUMPS, CENTRIFUGAL*—16 page Bulletin 721.6 describes single stage, double suction units in 34 sizes providing capacities from 100 to 6400 gpm with heads up to 525 ft. Choice of grease or oil lubricated bearings, available in stainless steel and ductile iron. Complete specifications, interchangeability of parts chart, performance curves, and dimensions given. *Goulds Pumps, Inc.*, 219 *Black Brook Rd., Seneca Falls, N.Y.*

▸ *PUMPS, CENTRIFUGAL*—four page Bulletin 2050 describes series "G" units. Pumps feature automatic thrust balance, large bearings, and oil filled stator cavity. Includes com-

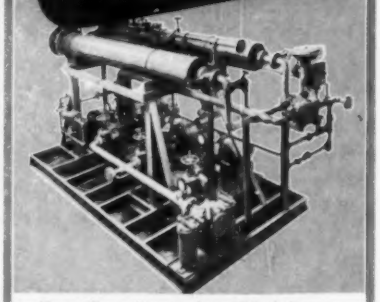
save on installation and maintenance

with

EAGAN

"pre-packaged"

FUEL OIL PUMP and HEATER SETS



Use an Eagan "pre-packaged" fuel oil pump and heater set for the preparation of heavy oil for combustion. You save time and money because units are completely assembled, ready for immediate installation. Only connections to oil and steam supply, burner, by-pass and relief lines have to be made and you avoid the combustion difficulties so often caused by field assembled combinations.

Here are additional benefits Eagan gives you:

- **Generous reserve capacity, at least 50% over peak burner demand, allows for eventual wear and future demand increases.**
- **Maintenance is easy and at a minimum. Parts requiring service are easily accessible.**
- **"Honest", solid construction, excellent engineering assure long life, trouble-free operation.**
- **Compact units save space.**

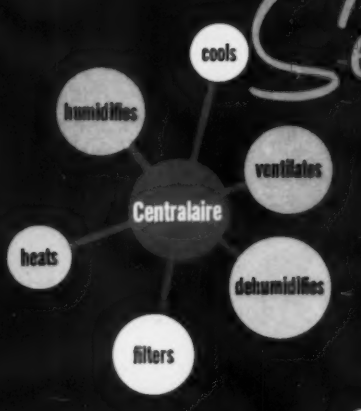
EAGAN fuel oil pump and heater sets heat to 300° F, pump to 400 psi and have capacities to 3000 gph. Single or duplex units are available for steam or electric drive. Duplex "electro-steam" sets provide for electrical failure by incorporating one steam pump and one electric motor driven pump. Other EAGAN sets can be made to your special requirements.

Write, wire or call for further information or let us bid on your job.

WALTER H. EAGAN CO., INC.
2337 Wallace Street, Phila. 30, Penna.
CEnter 6-2300

Mfrs. of condensate, boiler feed, turbine, centrifugal and proportioning pumps and fuel oil pump and heater sets.

Pump Specialists Since 1920



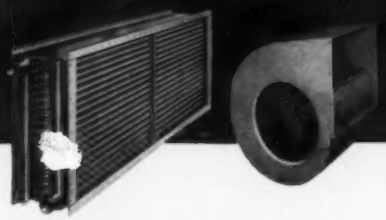
Sectionalized Design

enables one unit to perform up to six different air handling jobs!

AIRTHERM CENTRALAIRE

CHOICE OF FAN & COIL SIZES

By using one of two different fan sizes, Centralaires can operate at or near top efficiency regardless of system static pressure and air volume needs. Three coil face area sizes—from which one is selected—enables the coil face velocity to meet design conditions and match the fan.



GRAPHIC SELECTION METHOD FEATURED IN NEW BULLETIN!

Contains an amazingly simple graphic selection method for fast, easy sizing. Gives the complete story on Centralaire units. Write for Bulletin No. 404 today!

Versatility that's practically unlimited! Sectionalized design permits *one* unit to meet *both* the space and air handling requirements of any commercial building needing 400 to 30,000 CFM output. Noise has been reduced to a lullaby level.

Utilizing steam or hot water, chilled water or refrigerant, this central station air handling unit performs all the functions of good air conditioning—heating, ventilating, cooling, dehumidifying, humidifying, and filtering, depending on specifications.

Cabinets are handsomely finished in mar-resistant metallic bronze... flush-mounted enclosure panels provide a trim, clean appearance.

See your Airtherm Representative for more information!

AIRTHERM MANUFACTURING COMPANY

P. O. Box 7039 • St. Louis 77, Mo.

For steam, hot water, chilled water systems

CABINET UNIT HEATERS • CABINET AIR CONDITIONING UNITS • VERTICAL & HORIZONTAL UNIT HEATERS • CONVECTORS

SC
New CLAIR COAT
LAGGING ADHESIVE
CREATED FOR THE TOUGHEST PIPE AND DUCT LAGGING APPLICATIONS.
A NEW AND EXCLUSIVE PRODUCT OF ST. CLAIR'S RESEARCH LABORATORIES.
Note THESE 10 HIGH SCORING POINTS
• FAST SETTING
Sets almost immediately for faster application.
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and is usable after being frozen solid.
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with fire retardant dried film
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Proved by comparative tests.
• ONE COAT NEEDED
for sleek, semi-gloss finish
• STEAM AND WATERPROOF
by contractor's tests
• VERMIN-PROOF
• FINE APPEARANCE
with long-lasting protection
• EASILY WASHABLE
• NON-TOXIC
and will not settle in container
Write for literature - samples - prices.
ST. CLAIR RUBBER CO.
Empire Bldg.
107 Clifford St. Detroit 26, Mich.

RECENT TRADE LITERATURE

Continued

plete performance curves and detailed cross-sections of line of canned pumps. *Chempump Div., Fostoria Corp., Huntingdon Valley, Pa.*

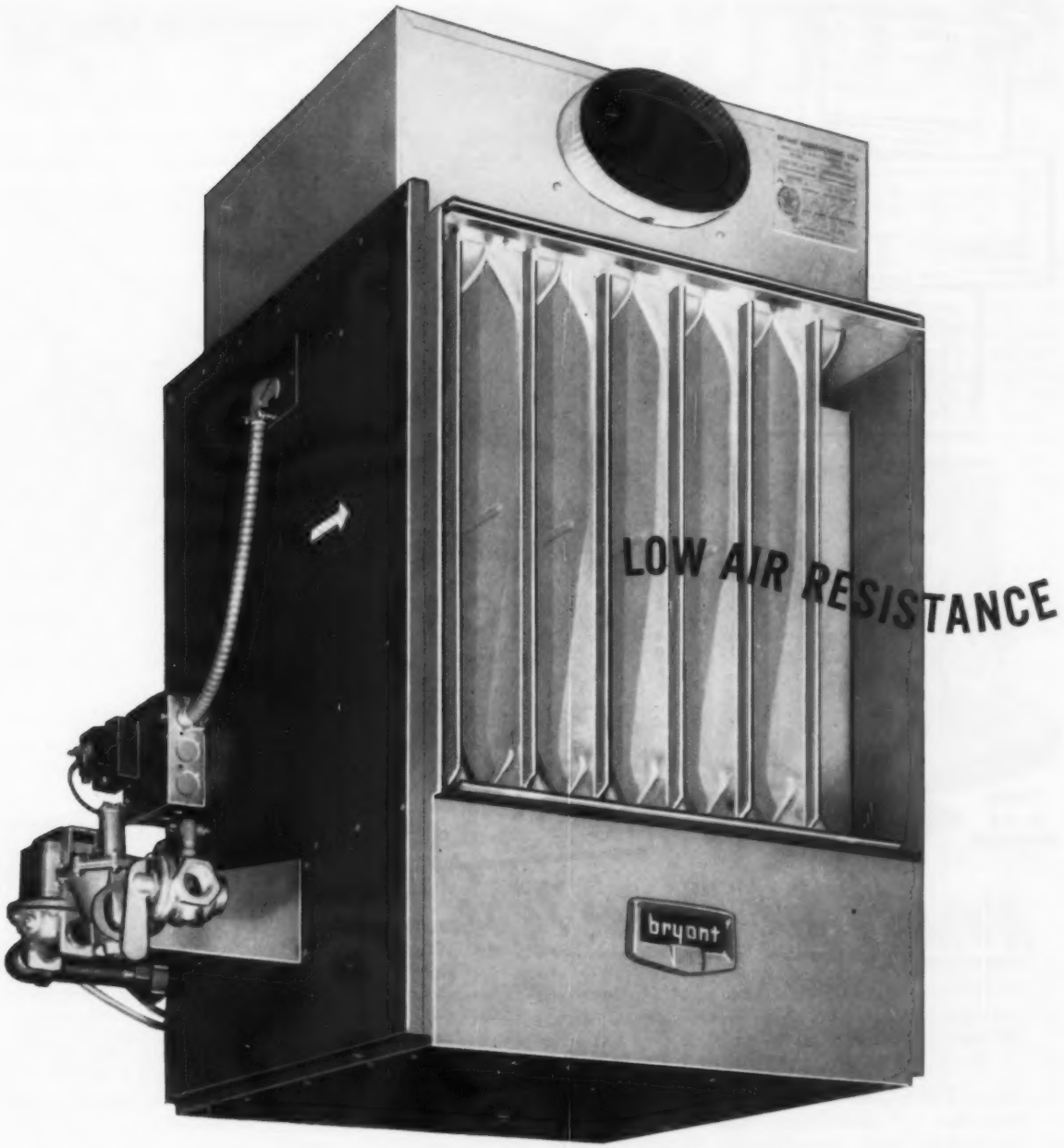
▸ *REGISTERS, GRILLES, DIFFUSERS, HEATING AND COOLING*—44 page catalog LRC-60 includes data for the design of perimeter systems, proper sizing and location of firm's products, conversion of cfm into Btu per hr at varying temperatures. Includes new series of "Thrifty" baseboard and floor diffusers, multi-valve heating-cooling registers, knob-operated ceiling diffusers, and high velocity curved-louver horizontal grilles. *Lima Register Co., 1790 N. Cable Rd., Lima, O.*

▸ *ROTAMETER, HIGH PRESSURE, INDICATING*—four page Bulletin No. 131 covers series "1400," designed for pressure up to 5000 psi at 200 F. Includes drawings, dimensions, and capacity tables. *Brooks Instrument Co., Inc., Hatfield, Pa.*

▸ *SAWS, POWER*—four page bulletin includes all new versions of three worm-drive saws: a 6½ in. top handle model, a two-speed jig saw, a two-speed reciprocating metal cutting hacksaw; and an all-purpose reciprocating saw. Motors withstand excessive, frequent overloading. *Skil Corp., 5033 N. Elston Ave., Chicago 30.*

▸ *SWITCHES, METAL-CASED*—16 page Catalog No. 30-1 describes hp-rated "KL" series and the double-break type "BK-1" switch. Listings include limit, safety, and other switches. Pictorial index shows location of dimensional drawings, descriptions, force and movement specifications, and electrical ratings. Data on bases, circuit arrangements, and NEMA standard definitions of precision snap-acting switch terms also given. *Unimax Switch Div., The W. L. Maxson Corp., Ives Rd., Wallingford, Conn.*

At the Air Force Academy...
Williams-Hager
Silent
CHECK VALVES
WRITE FOR BULLETINS: No. 659 on Pressure Loss Tests . . . No. 654 on Valves . . . No. 851 on Cause, Effect and Control of Water Hammer
Sure
PROTECTION
FOR THEIR HIGH-PRESSURE SYSTEM
Air Force Academy's extensive heating system is protected and silenced by Williams-Hager Check Valves which operate instantly when flow reversal starts or when flow is zero.
The WILLIAMS GAUGE CO., Inc.
155 Stanwix Street
2 Gateway Center • Pittsburgh 22, Pa.
Our 75th Year • 1886-1961



NEW

FROM

bryant

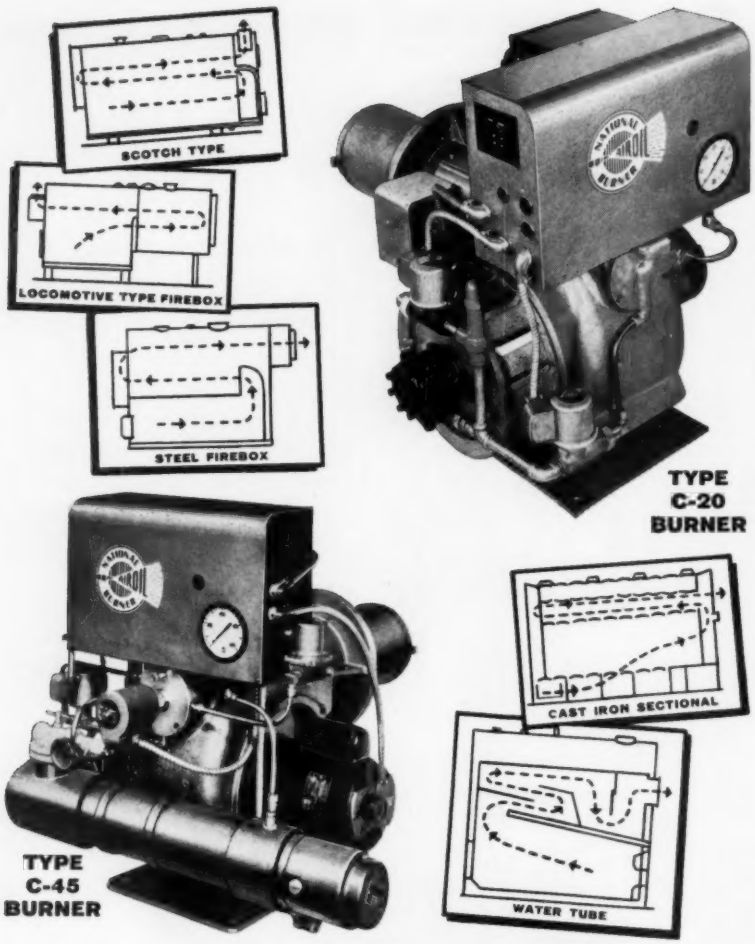
GAS-FIRED DUCT HEATERS

LOW OPERATING COST. The heat exchanger is engineered for low static pressure... permits moving more cfm per hp.

LONGER LIFE. The exclusive Tri-Alloy heat exchanger resists corrosion from extreme temperatures, moisture and flue gases.

COMPLETE LINE. Single units in eight sizes (50,000 to 250,000 Btu input) and twin units to 500,000 Btu. Matching blower packages — open or enclosed.

EASY INSTALLATION. Both flue and controls are readily reversible. For complete information call your local Bryant Distributor or Factory Branch, or write Bryant Manufacturing Company, Indianapolis, Indiana.



Name Your Boiler Type...

Whatever your unit . . . forced draft "pressurized", natural or induced draft . . . there are TWO National Airoil *job-engineered* oil burners ready to go to work to provide *better* performance . . . *at far greater economy!*

Select **TYPE C-45** for burning **Numbers 4 and 5** commercial fuel oils . . . 7 models with capacities to 33 gph . . . quiet, easy to install, high temperature flame, excellent combustion. Bulletin 100A.

Select **TYPE C-20** for burning the lighter **Number 2** fuel oil . . . 7 models with capacities to 33 gph . . . clean, pulsation-free operation. Bulletin 102.

These Underwriter-approved **package** burners offer a host of outstanding first-time features. Data is contained in our comprehensive literature and specifications. Just tell us your needs and you'll hear from us by return mail.

Established 1912
Incorporated 1917

NATIONAL AIROIL BURNER COMPANY, INC.
1284 E. Sedgley Avenue • Philadelphia 34, Pa., U.S.A.
Industrial Oil Burners, Gas Burners and Combustion Equipment

RECENT TRADE LITERATURE
Continued

▸ *TEMPLATE, PIPING SYSTEM*—includes the most commonly used welding fitting shapes to speed design and drawing time. *Bonney Forge and Tool Works, Cedar and Meadow Sts., Allentown, Pa.*

▸ *THERMOSTATS*—four page Bulletin 3500 describes "Type G" units featuring exposed or enclosed bimetal disc elements. Gives technical details on optional features such as available terminals, terminal mountings, and flange mounted assemblies. Ranges, tolerances, differentials, and ratings also given. *Stevens Manufacturing Co., Inc., P.O. Box* 1007, *Mansfield, Ohio.*

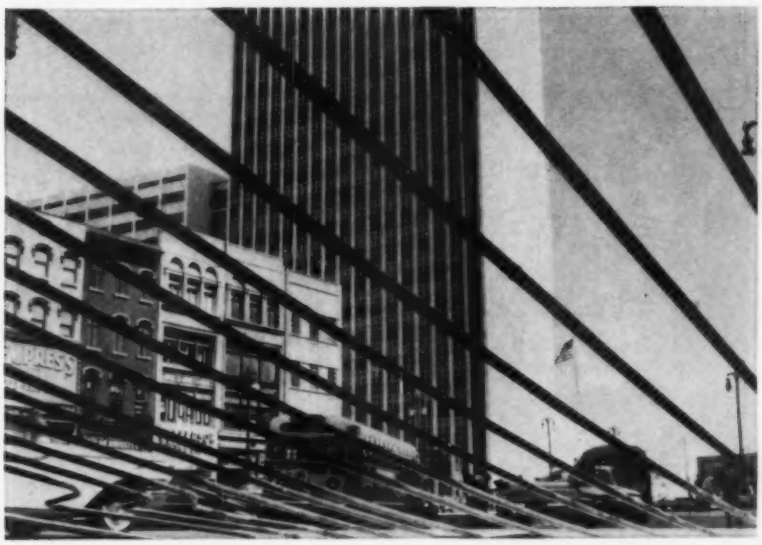
▸ *TREATMENT, WATER, FOR FUNGI, BACTERIA, ALGAE*—technical sheet describes chemical and physical properties and uses for "TBTO," used in control of fungi, bacteria, and algae in industrial cooling systems and other applications. *Metal & Thermit Corp., General Offices, Rahway, N.J.*

▸ *TREATMENT, WATER, FOR SCALE, CORROSION CONTROL*—16 page circular, "Solution to Your Problem of Scale and Corrosion Control" in form of a telescoped sheet of eleven different drums of firm's "H-O-H Glucosates." Product corrects and controls scale and corrosion in cooling water systems, boiler waters, etc. *D. W. Haering & Co., Inc., P.O. Box* 10337, *San Antonio* 21, *Tex.*

▸ *TREATMENT, WATER, FOR SCALE, CORROSION CONTROL*—four page bulletin HSP-940 explains use of powdered acid cleaner for use in cleaning scale desposits from boilers, heat exchangers, water lines, pumps and other equipment. Cleaner a free-flowing mixture of solid acid,

BYERS GUIDE

Tips on How to Minimize Corrosion Costs from A. M. Byers Co. VOL. 2, NO. 3



SNOW MELTING — Spaced on 12-inch centers, these 1-inch diameter 4-D Wrought Iron grids were positioned in the sidewalk outside the National Bank of Detroit and covered with concrete. In operation, hot water mixed with ethylene-glycol circulates through the pipes to melt ice and snow. This is another important application in piping where Wrought Iron's corrosion resistance pays off.

Why So Many Buildings, Completed in 1960, Have Byers 4-D Wrought Iron Pipe

4-D Wrought Iron pipe was *specified* for plumbing in many buildings completed in 1960. Services included hot and cold water lines, soil, waste and vent lines, leaders and downspouts as well as miscellaneous plumbing lines such as gas and vacuum sweeper lines. In each of these areas, 4-D was specified to minimize corrosion and therefore cut future maintenance costs. Here is why:

PERMANENCE—4-D Wrought Iron pipe has a "built-in" capacity to resist corrosive attack. This adds to the service life of the building, and increases its value. Corrosion resistance is of particular importance in areas where inaccessibility makes piping failure a major expenditure.

SPACE SAVING—Durham Systems save both space and weight, eliminate weak, bulky, lead-wiped joints. Longer runs are possible without danger of damage from settlement, vibration or temperature variations.

EASY INSTALLATION—4-D's availability on random lengths results in fewer joints, fewer supports and lower labor costs.

These are some of the cost-cutting reasons why engineers and contractors specify and install Byers 4-D pipe. For more of the facts on Byers Wrought Iron, check the appropriate box in the coupon below.

Heating, Air Conditioning Lines—Corrosion Target

Steam heating plants are particularly subject to corrosive attack. In such areas as condensate return lines, steam lines and even fuel oil lines, the very nature of the material carried makes chemical protection of the lines difficult—in some cases, impossible. Here Byers 4-D Wrought Iron pipe's ability to stand up to corrosion can save far more than the original cost of the system.

The unique composition of Wrought Iron is responsible for its selection as a *permanent* piping material. It is a two-component metal, made up of high-purity iron and glass-like fibers or iron silicate. There are approximately 250,000 fibers per square inch of Wrought Iron. They bar the spreading of rust through the base metal. For complete information on the application of Wrought Iron to heating and air conditioning systems, use the coupon.

The Odds Are Five to One—You Can't Afford to Lose

SERVICE LIFE is the key to true piping economy. And nothing proves this so completely as contrasting installation costs with repair costs. This is especially true where piping is concealed—One man can install it, but if it has to be repaired, *five* men may be required—the pipe fitter, a carpenter, a mason, a plasterer and a painter. When you look at long term costs, the use of materials that will resist corrosion makes sense. Even short term costs can be reduced by this kind of preventive maintenance. Facts and figures on Byers 4-D Wrought Iron are yours for the asking—use the coupon.

A. M. BYERS COMPANY

PIPE PRODUCTS: Wrought Iron • PVC • Steel
ROLLED PRODUCTS: Plates, Billets and Bars • Wrought Iron, Stainless and Alloy Steel

A. M. Byers Company, Clark Building, Pittsburgh 22, Pa.

Please send data on items checked:

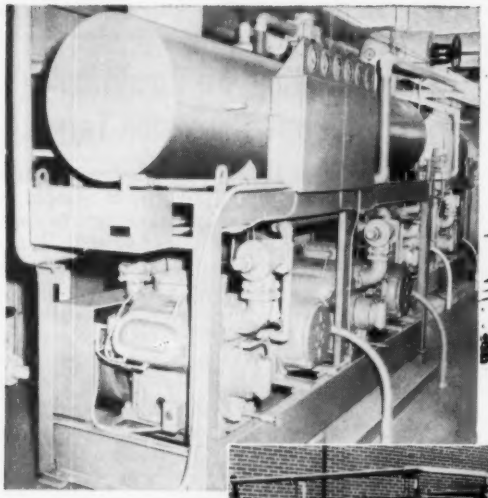
☐ Plumbing ☐ Heating & Air Conditioning ☐ Building Piping

Name_____ Title_____

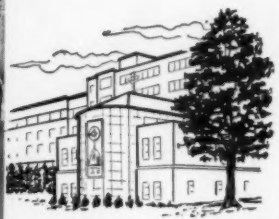
Company_____

Address_____

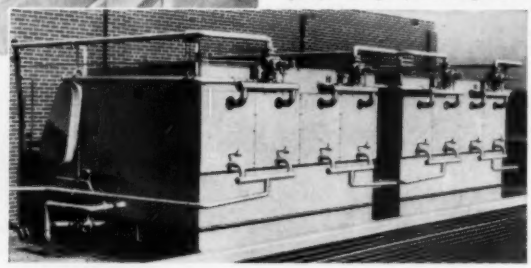
With Vilter air conditioning... it's almost a pleasure to be a patient here



View of the two Vilter packaged water chilling units arranged as four independent refrigeration systems. Two Vilter VMC compressors are included in each chiller unit.



New addition to St. Mary's Hospital, Huntington, West Virginia.



View of the two Vilter evaporative condensers, one for each packaged unit. Each condenser is divided into two separate sections to efficiently reduce capacity when required.

Efficient, flexible, quiet—the Vilter installation for the new addition at St. Mary's Hospital provides everything a hospital requires of an air conditioning system.

This system is designed around two separate Vilter Refrigerant 22 packaged water chilling units arranged as four independent systems supplying a total of 300 tons of refrigeration.

The performance advantages are — (a) an exceptionally flexible operating plant because of the four systems and the 33% and 66% capacity modulation built into each compressor; (b) lower starting and operating noise levels as a result of dividing the full load and using modern slow speed equipment; (c) maximum insurance against failure; (d) ease of servicing.

Four Vilter VMC compressors, V-belt driven from 75 H.P. motors, individually develop 76 tons as each water chiller cools 440 gpm from 53° F. to 45° F. with a 35° F. refrigerant temperature. Two Vilter evaporative condensers are utilized with each condenser divided by a baffle to actually provide four separate 100-ton units.

You benefit doubly with Vilter refrigeration and air conditioning equipment—(1) careful design for long life and reliable, efficient performance; (2) a complete and integrated line of equipment, and the experience to counsel you on the best type of installation. Why not let the nearest Vilter representative help you?

Sold by Vilter Distributor, Commercial Refrigeration Sales, Inc., Huntington, West Virginia.
Architect, Vecellio & Kreps; Consulting Engineer, L. O. Johnson; Mechanical Contractor, Dougherty Company, Inc.

Vilter® refrigeration air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin

Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

Write for Bulletins 820, 631 and 932 to The Vilter Manufacturing Company, Dept. F-601 2217 South First Street Milwaukee 7, Wisconsin

RECENT TRADE LITERATURE
Continued

corrosion inhibitor, and antifoam. Safe for use in systems containing iron, copper, copper alloys, brass and aluminum. *Hagan Chemicals & Controls, Inc., Hagan Center, Pittsburgh* 30.

▸ *VALVES, AIR CONTROL*—digest catalog Bulletin 60-2 describes 2, 3, and 4-way; and 4-way, 5-port poppet type valves in a single complete chart. Air and solenoid pilot operators coordinated in chart with compatible valves. Cutaway drawings show construction features, sealing arrangements, poppets, and flow pattern through units in normal position. *Hoffman Valves, Inc.*, 2360 *W. Dorothy Lane, Dayton* 39, *O.*

▸ *VALVES, CONTROL; REGULATORS, SLIDING GATE*—four page sizing chart, Bulletin JSC-1, gives sizing information for firm's units, covering steam, liquid, and gas service. Technical data (applying to all makes of valves) tells how to adjust sizing for variations in pressure, temperature, viscosity, or specific gravity. *OPW-Jordan*, 6013 *Wiehe Rd., Cincinnati* 13.

▸ *VIBRATION, STRAIN, ANALYZING INSTRUMENTS*—four page bulletin K19A describes units for measuring, recording, and analyzing vibration and strain. Contains data charts and specifications of vibration transducers and exciters, strain gages, load cells and beams, engine monitoring equipment, together with their associated read-out devices and recorders. *The Korfund Co., Inc., Instruments and Acoustics Div., Cantiague Rd., Westbury, L.I., N.Y.*

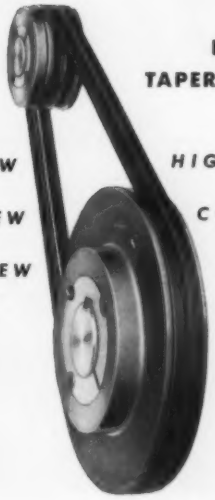
▸ *WELDING*—24 page booklet, "Hobart Arc Welding News, AWN-165," includes articles on arc welding processes. *Hobart Brothers Co., Hobart Sq., Troy, O.*

an entirely new line of
V-Belt Drives.....

DODGE Dyna V

BIG-GROOVE TAPER-LOCK DRIVE

(— using standard A, B, C, D and E cross section belts, the hp ratings of which have been increased an average of 40% without any increase in cost)



DYNA-V TAPER-LOCK DRIVE

NEW HIGH CAPACITY
NEW COMPACTNESS
NEW SAVINGS IN COST

COMPARISON ILLUSTRATED ABOVE — 3 HP, 1750 RPM, 2.41 TO 1 RATIO

	BELTS		SHEAVES			CENTER DIS-TANCE	HP	WEIGHT (LBS.)	COST	
	Number	Size	O.D. Driver	O.D. Driven	Width				Per hp	Per Drive
BIG-GROOVE TAPER-LOCK DRIVE	3	A42	4.15"	8.95"	2½"	12.3"	4.62	24.7	$5.55	$25.73
DYNA-V TAPER-LOCK DRIVE	2	3V400	3.35"	8.00"	1 3/32"	10.8"	5.0	18.0	$4.50	$22.41
% SAVING *Savings vary with different sized drives*			**19%**	**10%**	**56%**	**12%**	+	**27%**	**18.9%**	**12.5%**

Dyna-V Drives are sensationally compact. They are capable of handling up to three times as much horsepower in a given space. Dyna-V opens vast new possibilities for better, more economical equipment design. And, in most instances, *Dyna-V costs less!*

Narrower grooves, to match stronger, narrower Dyna-V Belts, greatly reduce the face width and the weight of Dyna-V Sheaves. Cost is lowered. Smaller diameter sheaves and shorter center distances multiply savings.

Dyna-V Sheaves decrease shaft overhang—increase bearing life. The new dimensional stability of Dyna-V Belts solves the problem of belt matching. Every belt carries its full share of the load.

Dyna-V Drives are available for capacities from 1 to 1500 hp. Ask your Dodge Distributor. Or write us for new Dyna-V Bulletin.

DODGE MANUFACTURING CORPORATION, 1600 Union St., Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery".

Mr. Louis E. Bake, *Air-Conditioning Dealer,* says:*

"Selling with the A.R.I. Directory is easier, faster, more profitable."

How profitable? Ask Louis Bake, who uses the ARI Directory regularly, finds it a big help in closing sales, and a major factor in his company's 50% sales increase in 1960.

"When I show customers that the unitary system I'm recommending is listed in the ARI Directory, and *certified* under the program of this national association, I add authority to my presentation.

"I point out how the equipment is carefully rated under the Certification Standards, that this rating is subject to checking at any time by the Institute through an independent testing laboratory in New York. Result: I back my sales talk with the authority of the Air-Conditioning & Refrigeration Institute, give my prospects more confidence in what I say.

"I thought selling with the ARI Directory couldn't be beat—until I saw the new ARI Consumer sales piece, 'How to Buy Central Air Conditioning.' This is a *must* for any dealer who wants to tell his prospects the *how* and *why* of central air conditioning. It tells the full, technical story in words John Q. Public can understand, and helps any honest dealer sell a quality system."

Free copies of both the A.R.I. Directory and "How to Buy Central Air Conditioning" are available from:

AIR-CONDITIONING & REFRIGERATION INSTITUTE

Department H-311 1346 Connecticut Avenue, N.W., Washington 6, D. C.

*Mr. LOUIS E. BAKE is Sales Manager of Cool-Heat Sales Company, Inc. of Washington, D. C.

SAVE
with
ROCKWELL
RESILIENT SEATED
BUTTERFLY VALVES

SAVE SPACE

Valve face-to-face is a fraction of the face-to-face of a gate valve. We call it a "wafer" valve.

SAVE WEIGHT

From 60 to 80 percent, depending on size.

SAVE COST

In initial outlay and in overall maintenance.

SAVE TROUBLE

Valve disc shuts off leak-tight against resilient seat from maximum line pressure to high vacuum. The disc cannot jam. Valve is self-cleaning. "Keelok" snap-in type liner is renewable. Control may be manual or automatic.

Write for Bulletin 590X

W. S. ROCKWELL COMPANY
2700 Eliot St. • Fairfield, Conn.

Made and sold in Europe by
COCKBURNS, Ltd., Glasgow S.W.2, Scotland

WHO'S WHAT...

(New personnel, promotions)

▸ *AMERICAN-STANDARD INDUSTRIAL DIV.* — Jack A. Hallinan, director of engineering, Kewanee (Ill.) plant.

▸ *WATER SERVICE LABORATORIES, INC.* — Walter P. Thurber, assistant vice president of engineering; and James B. Fullman, chief engineer.

▸ *PHILCO CORP.* — Walter S. Bopp, vice president and general manager, International Div.

▸ *BREEZE CORPS., INC.* — Dr. Melville F. Peters, director of research and development.

▸ *HOTSTREAM HEATER CO.* — Ralph R. Mendelson, president and chief executive officer.

▸ *PALL CORP.* — Howard E. Abrams, laboratory manager.

▸ *UNION CARBIDE PLASTICS CO.* — Philip A. Thomas, assistant director of development.

▸ *CARLON PRODUCTS CORP.* — John I. Rudge, president.

▸ *FEDDERS CORP.* — Joseph Giordano, vice president of engineering.

▸ *WHITLOCK MANUFACTURING CO.* — Gordon Bennett, president.

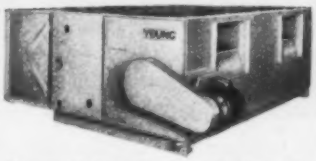
▸ *JOHN WOOD CO.* — Stuart F. Faunce, vice president and director of research.

▸ *ANSUL CHEMICAL CO.* — William R. Rinelli, vice president.

▸ *YORK DIV., BORG-WARNER CORP.* — Richard F. Kelley, general sales manager, packaged products.

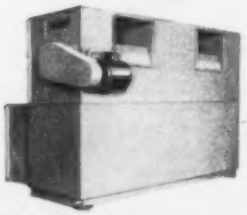
Young
BUILDS THE BEST CENTRAL STATION AIR CONDITIONING EQUIPMENT

HORIZONTAL UNITS



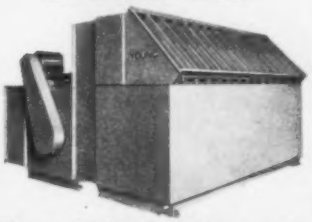
Young CS Horizontal Air Conditioning Units are the solution where "tailor-made" units are needed to meet exacting requirements. Interchangeable sectional design in 10 sizes with capacities from 700 cfm to 28,000 cfm.

VERTICAL UNITS



Sectionally designed Vertical Units are available in the same wide range of sizes and capacities. All types can be assembled in any combination from simple ventilation to complete air conditioning.

MULTIZONE UNITS



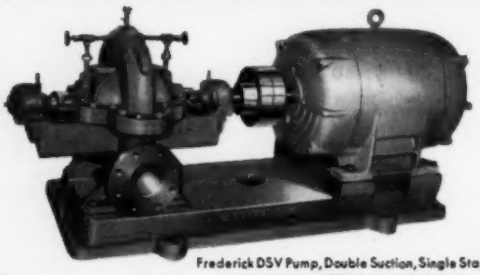
Young Multizone Units provide individual area control of air conditioning from a single unit. Nine sizes and a selection of 2 to 21 zones. Ample access panels permit easy servicing.

Write for Catalog No. 7558A
Dept. C-511

YOUNG RADIATOR CO.
RACINE, WISCONSIN
Plants at Racine, Wis. and Mattoon, Ill.

FREDERICK CENTRIFUGAL PUMPS

for Air Conditioning, water supply, drainage and fire protection.



Frederick DSV Pump, Double Suction, Single Stage
Available in 1½" through 24" discharge

CUSTOM-BUILT FOR EFFICIENT, DEPENDABLE SERVICE

Whatever your air conditioning or other pump needs, you can choose from a complete line of Frederick Centrifugal Pumps—custom engineered and built for you. Exclusive features assure long service life under the most rugged conditions. In fact, many Frederick Pumps have been in service for over 40 years. Easy to install, easy to operate. Prompt repair service and parts available.

Write for Bulletin 104-A describing mechanical features, giving technical data.

Frederick IRON & STEEL, INC.
FREDERICK *Established 1890* MARYLAND

Processing, heating and air conditioning FOREIGN MATTER REMOVAL!

Specify Keckley Strainers for safe, sure removal of foreign matter from distribution systems — *ahead* of pre-heat and re-heat coils, control valves, steam traps, pumps and other equipment.

Assure your next processing, wet heat or air conditioning installation of maximum performance with Keckley Strainers — the best performance insurance you can buy.

Write for your copy of Bulletin 260 showing Keckley's complete line of steam and liquid control equipment.

Y-Type Self-Cleaning Strainers

In ¼" to 12" pipe sizes in semi-steel bodies to 250 lbs. steam, bronze bodies to 300 lbs. steam, and cast steel bodies to 600 lbs. steam. Screwed or flanged connections. All size perforated brass, stainless steel or monel screens available, as well as wire meshes, for proper media selection.

Basket Type Strainers

For pressure and suction pipe lines. Basket lifts from top, cleans easily. Semi-steel bodies to 250 psi, bronze bodies to 300 psi, and steel bodies to 600 psi. Brass or stainless steel screens. Also available with vertical blow down.

O. C. KECKLEY COMPANY
General Offices and Factory
3400 CLEVELAND ST., SKOKIE, ILLINOIS

KECKLEY

Pressure Regulators • Temperature Regulators • Float Valves
Strainers • Solenoid Valves • Reducing Valves
Pop Safety Valves • Relief Valves

WHO'S WHAT

Continued

▸ *BRABANT BRASS MANUFACTURING CO.* — William J. Wildern, vice president and general manager.

▸ *DRYER DYNAMICS CORP.* — Paul E. Evans, sales manager.

▸ *McGRAW-EDISON CO.* — William H. Lewis, advertising and sales promotion manager, Albion Div.

▸ *BETTCHER MANUFACTURING CORP.* — Joseph W. Adams, manager of Panelbloc Div.

▸ *DIEHL MANUFACTURING CO.* — Elwood R. Zeek, vice president of research and engineering.

▸ *CLAYTON MARK & CO.* — James Oakley, vice president of manufacturing; and James Zamrazil, manager of industrial relations.

▸ *CRANE CORP.* — H. R. Riggs, vice president; S. E. Coletti, director of advertising; and V. C. German, general manager of the Cochrane Corp., Crane division.

▸ *ARNO ADHESIVE TAPES, INC.* — William A. Donahue, industrial sales manager.

▸ *DANFOSS INC.* — Thomas H. Ford, executive vice president and general manager.

▸ *THE NATIONAL COPPER & SMELTING CO.* — Richard B. Flynn, sales manager.

▸ *HOOKER CHEMICAL CORP.* — Stanley A. Mattison, director of public relations.

▸ *CLEAVER-BROOKS CO.* — Hugh G. Dean, sales manager of Springfield Boiler Co.

Now! Skil Roto-Hammers drill 3½″ holes in reinforced concrete

using new percussion carbide tipped Skil Core Bits!

There are plenty of good reasons why the Skil Roto-Hammer is sure to be the world's largest selling hammer again in 1961! But one of the foremost is Skil's new core bits.

These hollow core, percussion type carbide bits increase the range of the Model 726 Roto-Hammer from 1⅛″ up to 1½″ and the Model 736 from 2″ up to a full 3½″!

What's more, they drill right through stubborn steel reinforcing rods—an impossibility with solid carbide bits or star drills.

This means that the hammer that already drills masonry holes at the *lowest cost per hole* and with *lowest hammer maintenance*, has tremendous added versatility.

Ask your Skil distributor for a demonstration soon. Look under "Tools-Electric" in the Yellow Pages. Or write: Skil Corporation, Dept. 134-C, 5033 Elston Avenue, Chicago 30, Illinois.

Skil Roto-Hammers combine power rotation with powerful hammering to drill holes in masonry (¼″ to 3½″) 5 to 6 times faster than ordinary electric hammers! Lowest maintenance—no springs to break.

SKIL . . . and SKILSAW POWER TOOLS

Where Performance Counts...

Jacksonville Coliseum
Jacksonville, Florida

Architects:
A. EUGENE CELLAR and GEO. RYAD FISHER
Mechanical and Electrical Engineer:
FRANK B. WILDER and ASSOCIATES
General Contractor:
DANIEL CONSTRUCTION COMPANY
Mechanical Contractor:
GREELISH and CO., INC.

GENERAL heaters selected for Jacksonville Coliseum

One of five instantaneous heaters of various sizes at the beautiful new Jacksonville Coliseum is an 18" converter for the ice rink. This unit heats brine from 15° to 324°F. at the rate of 700 gpm (5,250,000 BTU's per hour). Once again General quality has been recognized and specified . . . as in so many of the country's largest installations.

Compact General heaters permit maximum installation flexibility . . . require minimum piping, minimum space. No storage tanks needed.

Simplified design facilitates installation, cuts maintenance costs. Water, heated only as required, promotes operating economies. Available in 4" to 28" diameter sizes . . . to handle 1 to 1800 gpm. Request Bulletin 61 for complete details.

GENERAL FITTINGS COMPANY
EAST GREENWICH • RHODE ISLAND

WHO'S WHAT *Continued*

▸ *LENNOX INDUSTRIES INC.* — Robbie L. Stephens, sales manager.

▸ *BARNEBEY-CHENEY CO.* — Don Connor, public relations manager.

▸ *THOR POWER TOOL CO.* — Robert P. Budler, public relations director.

▸ *COMBUSTION ENGINEERING, INC.* — Carmine J. Grossi, export sales manager.

▸ *KENSICO TUBE CO.* — Fred F. Moore, Jr., vice president.

▸ *AIR CONDITIONING INC.* — Peter J. Dalton, vice president of sales.

▸ *SIMPSON ELECTRIC CO.* — Charles R. Billman, vice president of manufacturing.

▸ *WORTHINGTON CORP.* — William H. Wheeler, general sales manager of the Construction Equipment Div.

▸ *SCHAEVITZ ENGINEERING* — Russell C. Spera, vice president of production.

▸ *OLIN MATHIESON CHEMICAL CORP.* — Vincent F. Villella, manufacturing superintendent, Ramset Fastening System.

▸ *PENNSALT CHEMICALS CORP.* — Dawes Walter, manager of advertising and public relations.

▸ *PITTSBURGH CORNING CORP.* — Russell Brittingham, vice president of manufacturing.

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THIRD EDITION

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15 CHAPTERS — 6"x9¼"

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GENERAL DATA
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STEAM DISTRIBUTION
METERING
BUILDING HEATING SYSTEMS
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CONSUMERS' ACCESSORY EQUIPMENT
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SALES ACTIVITIES
HOT WATER FOR DISTRICT HEATING

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YOUR ASSURANCE OF PROPERLY RATED PERFORMANCE IN AIR MOVING DEVICES

The AMCA program of Certified Ratings provides assurance of properly rated performance to specifiers and users of centrifugal fans, axial and propeller fans, power roof ventilators and other air-moving devices. To qualify for license under the Certified Ratings Program, manufacturers must meet the following basic requirements:

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These published performance ratings must be developed for various volumes, pressures and speeds—at a stated density...

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2159 Guardian Building, Detroit 26, Michigan

Please send Bulletin 211—The AMCA Certified Ratings Program for Air Moving Devices

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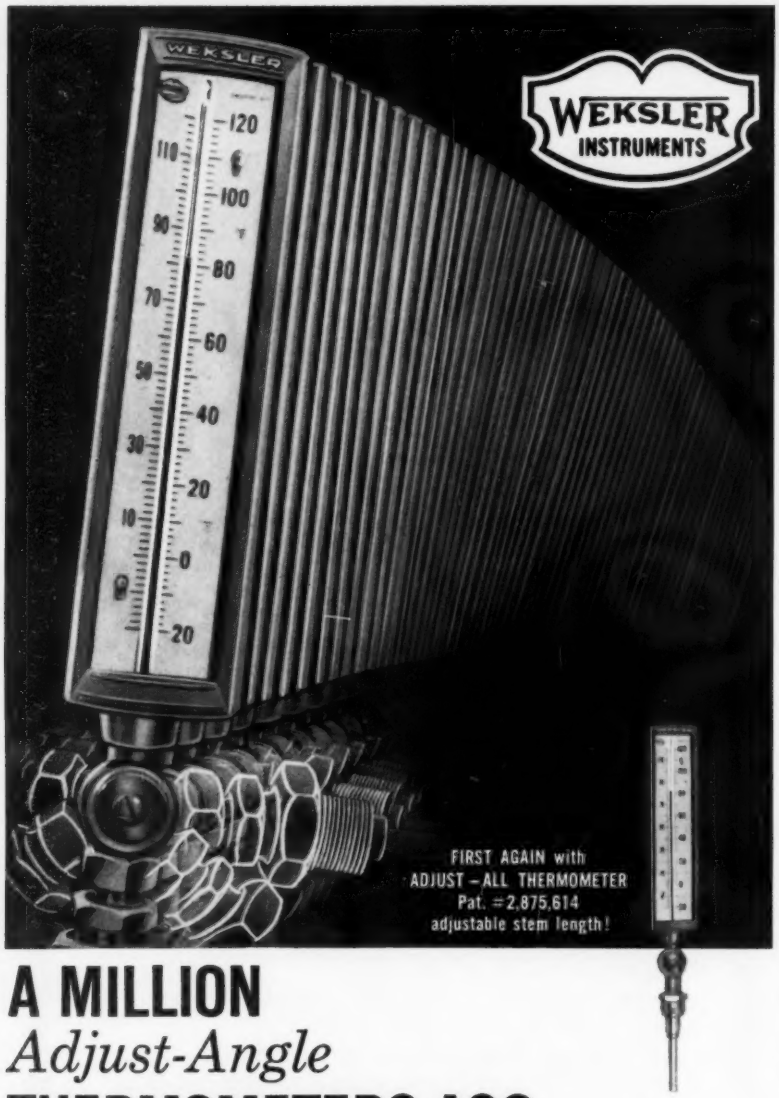


A MILLION *Adjust-Angle* THERMOMETERS AGO

...takes us back thirteen years, to U.S. Patent No. 2,524,894 awarded to **Weksler.** Until a few months ago, Weksler was the **only** adjust-angle thermometer you could buy. Today you have a choice from several different manufacturers who are in first model production of this remarkable instrument.

Thirteen years experience with a precise instrument represents a world of know-how...a decisive consideration in your **choice** of Weksler!

NEW WEKSLER ADJUST-ANGLE INDUSTRIAL THERMOMETERS, COMPLETELY REDESIGNED, ARE FULL 2-INCH WIDTH... EASY READING... HIGHEST ACCURACY IN ANY RANGE YOU DESIRE. 7- 9- 12-INCH SCALE SIZES, PLUS EXCLUSIVE 5" SCALE SIZE!

Write for Bulletin AA-60

WEKSLER INSTRUMENTS

"ORIGINATORS OF WORLD RENOWNED ADJUST-ANGLE THERMOMETERS"

WEKSLER INSTRUMENTS

CORPORATION

195 EAST MERRICK ROAD, FREEPORT, L. I., N. Y.

Indicating and Recording Instruments for Temperature, Pressure and Humidity

WHO'S WHAT

Continued

▸ *A. LYNN THOMAS CO., INC.* — Richard M. Dillion, executive vice president.

▸ *FLEXONICS CORP.* — Lloyd G. Fox, vice president and director of marketing.

▸ *MUELLER BRASS CO.* — Orville R. Payton, director of sales and promotion; and Philip L. Wixson, advertising manager.

▸ *COOPER ALLOY CORP.* — Gerald Lewis, vice president of marketing and engineering.

▸ *BOHN ALUMINUM & BRASS CORP.* — Willard B. Buck, sales manager, air conditioning.

▸ *THE VILTER MANUFACTURING CO.* — Erich J. Kocher, chief engineer, elected a director.

▸ *THE WEINMAN PUMP MANUFACTURING CO.* — Dr. L. Kermit Herndon, chairman of the board and chief executive officer; and P. W. Holstein, secretary, elected vice president.

▸ *BLACK, SIVALLS & BRYSON, INC.* — Paul Bartley, vice president of sales.

▸ *H. K. PORTER CO., INC.* — Walter A. Curtis, general manager of Peerless Electric Div.

▸ *TACO HEATERS, INC.* — Hubert A. Essley, vice president of operations.

▸ *BORG-WARNER CORP.* — William B. Shimer, director of manufacturing services.

▸ *ALUMINUM CO. OF AMERICA* — Edward T. Wanderer, development manager, machinery and equipment.

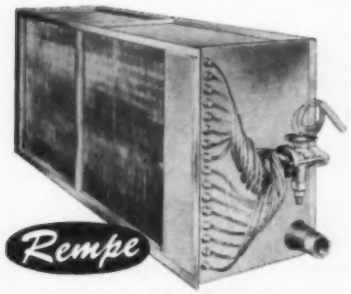
REMPE
Heat Transfer Equipment

FABRICATED
PIPE COILS

Unlimited Applications
Coils illustrated are a double spiral made from nickel pipe. They were designed for use as part of a continuous fat splitting unit employing the Eisenlohr Process. The coils were tested to 12,000 lbs. hydrostatic pressure for operation at 3,500 lbs. steam pressure and 600° F.

Send Drawings for Quotation

STAINLESS STEEL — FIN TYPE
COOLING COILS

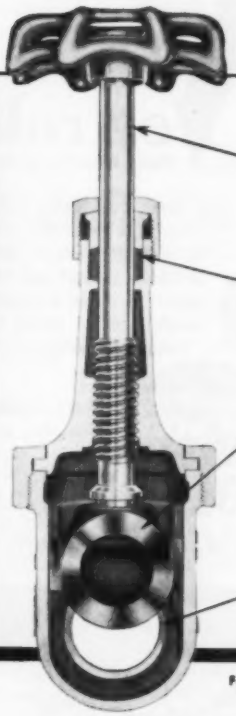


For Corrosive Atmosphere
Rempe Stainless Steel Cooling Coils can be furnished of gas-tight construction as illustrated for handling air contaminated with varying concentrations of acid vapors. Ideally suited for all types of corrosive air mixtures, gas or liquid cooling requirements. Details on request.

Engineering Data Book
Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

REMPE COMPANY
342 N. Sacramento Blvd. • Chicago 12, Ill.

Outstanding Valve performance with
KENNEDIZED DISCS
an entirely new development in bronze gate valve construction that extends service life beyond comparison . . .



PROVEN BY USE!

KENALLOY STEM . . .
Exclusive KENNEDY alloy that prevents dezincification and corrosion and provides smooth, non-galling threads and bearing surfaces. In a rugged use test, this stem withstood a mechanical loading of 18 foot-pounds closing torque and after 25,000 cycles was like new!

PACKING . . .
New type packing made of molded graphite asbestos with a Buna "N" binder required no replacement during or after 25,000 cycles.

KENNEDIZED DISC . . .
In punishing use tests, the super mirror finish of the KENNEDIZED disc actually improved with wear! Disc showed no galling or other wear marks after 25,000 cycles at 150 lbs. saturated steam pressure. This remarkable wear resistance is combined with an extremely low coefficient of friction, smooth sliding properties, excellent anti-seizure characteristics and corrosion and galling resistance. Tests and in-use results prove these discs set a new and unmatched high standard in valve performance.

SEAT . . .
Due to the low coefficient of friction and smooth sliding properties, the action of the KENNEDIZED disc actually improved the finish on the seat. Here, again, no galling was found on the seat after 25,000 cycles.

For the complete KENNEDIZED DISC story, write for Bulletin 574.

Fig. 525KD
125-Pound S.W.P.
Bronze Gate Valve.

KENNEDIZED DISCS
NOW AVAILABLE IN THESE KENNEDY VALVES . . .

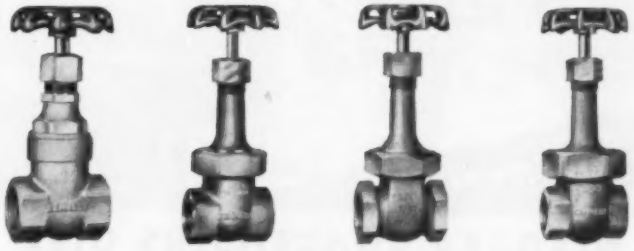


FIG. 427KD
125-Pound S.W.P. Bronze Gate Valve—Non-Rising Stem, Inside Screw, KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs.; W.O.G., Non-Shock, 200 lbs.

Fig. 525KD
125-Pound S.W.P. Bronze Gate Valve—Union Bonnet, Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs., W.O.G., Non-Shock, 200 lbs.

Fig. 78KD
200-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3", Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 200 lbs.; W.O.G., Non-Shock, 400 lbs.

Fig. 518KD
300-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3", Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 300 lbs.; W.O.G., Non-Shock, 600 lbs.

KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK
• OFFICE AND WAREHOUSES IN PRINCIPAL CITIES
DUCTILE IRON VALVES • CAST IRON VALVES • BRONZE VALVES • INDICATOR POSTS • FIRE HYDRANTS

You get

INDEPENDENT UNIT CONTROL

for hot or chilled water systems with . . .

The Vectrole

Water Diverting Valve

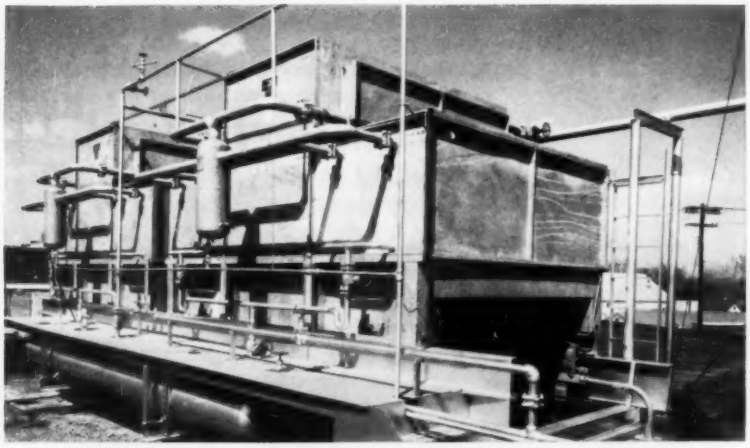
For year 'round comfort automation at a reasonable price, the Chatleff Vectrole Valve, Switching Element and Thermostat give you a complete comfort control system at a tremendous saving.

SOLID BRASS CONSTRUCTION

For complete information, write:

CHATLEFF CONTROLS INC.

205 Industrial Blvd., Austin 4, Texas



NIAGARA CONDENSERS GIVE YOU LONGER SERVICE

● Refrigeration plant operators who know their costs prefer Niagara Aero Condensers. Niagara design assures lower cost, more durable equipment, easier and cheaper to maintain.

You always get full condensing capacity, operating at the lowest possible head pressure, cutting the cost of power. You continue to hold "new plant" efficiency keeping your savings continuous, year after year.

Niagara Aero Condensers out-last as well as out-perform other types and give you the lowest costs in the long run. Users say they "prevent half the operating troubles" of a refrigerating plant. They have held this record for over 30 years.

Write for bulletins 131 and 142.

NIAGARA BLOWER COMPANY

Dept. HP-3, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U.S. and Canada

WHO'S WHAT

Continued

▸ *GENIE-AIR PRODUCTS* — W. C. Walter, national marketing manager.

▸ *DOLE REFRIGERATING CO.* — L. M. Nelsen, national service manager.

▸ *JAMESBURY CORP.* — Maxwell H. Reck, sales manager.

▸ *CONOFLOW CORP.* — J. Robert Simpson, general sales manager, elected a vice president.

▸ *COPELAND REFRIGERATION CORP.* — Rudolf G. Berg, Benjamin W. Moreland, and Frank J. Gleason, Jr., members of the board of directors.

▸ *SONOCO PRODUCTS CO.* — E. S. Reid, director of technical services; and J. C. Fort, sales manager, Construction Products Div.

▸ *WALTON LABORATORIES, INC.* — Herbert E. Puttbach, sales manager.

▸ *YORK-SHIPLEY, INC.* — William A. Lake, vice president of marketing.

▸ *PARKER-KALON* — Arnold Rofheart, advertising manager.

▸ *DRESSER INDUSTRIES, INC.* — James M. Hughs, sales manager, regular products, Manufacturing Div.

▸ *YORK DIV. OF BORG-WARNER CORP.* — M. V. Bailliere, Jr., and Caryl C. Lewis, vice presidents.

▸ *PORTER-CABLE CO.* — Joseph J. Diamond, vice president of field sales.

▸ *HI-PRESS AIR CONDITIONING OF AMERICA, INC.* — Irv. Secord, sales manager, Drayer-Hanson Div.

Install Insulation with

TUFF-BOND

Super-Strength Adhesives

TUFF-BOND #7
. . . fire-retardant adhesive for installing insulation

TUFF-BOND M-102-H
. . . duct liner adhesive

TUFF-BOND 21-C
. . . clear lap sealer and lap adhesive

TUFF-BOND 21-W
. . . white lap sealer and lap adhesive

TUFF-BOND #6
. . . non-flammable fire-retardant duct liner adhesive; meets Interim Federal Standard #00136.

TUFF-BOND #9
. . . for bonding rigid and semi-rigid plastic foams (polystyrene, urethane, isocyanate, etc.) to themselves and to other materials.

TUFF-BOND #12
. . . high pressure duct sealer

TUFF-BOND QUIK SET
. . . neoprene-base, fast-setting adhesive. Recommended for installing metal and nylon hangers to smooth surfaces.

TUFF-BOND GENERAL PURPOSE IMPROVED
. . . all-around adhesive for installing insulation, insulation hangers, etc.

Ask for literature and prices.

GOODLOE E. MOORE
INCORPORATED
DANVILLE 26, ILLINOIS

WHO'S WHAT

Continued

▸ *PECK, STOW & WILCOX CO.* — Walter J. Hushak, assistant to the president.

▸ *THE SIEGLER CORP.* — H. Chapman Rose and Chester A. Thompson, members of the board of directors; and General Phillips W. Smith, vice president.

▸ *HUPP CORP.* — Roland E. Pillat, sales manager, Typhoon Heat Pump Div.; and Sydney Anderson, vice president in charge of west coast operations for Typhoon Air Conditioning Div.

▸ *FAFNIR BEARING CO.* — Horace B. Van Dorn, vice president of engineering; and Ronald P. Remorenko, assistant chief engineer.

▸ *YUBA CONSOLIDATED INDUSTRIES, INC.* — R. A. Beck, vice president and director of sales; Frederick H. Linley, Jr., sales manager; Arnold R. McLain, general manager of the Heat Transfer Div.; and Herbert O. Johnson, general manager of the Manufacturing Div.

▸ *ROBERTSHAW-FULTON CONTROLS CO.* — Alton W. Beck, vice president, western operations; and Edward B. Maire, general manager of the Bridgeport Thermostat Div.

▸ *CARRIER AIR CONDITIONING CO.* — Hermann C. Hoffmann, general sales manager.

▸ *ARMSTRONG CORK CO.* — C. N. Painter, senior vice president and a member of the president's office; M. J. Warnock, first senior vice president.

▸ *HANDY & HARMAN* — M. W. Townsend, executive vice president.

▸ *GOULDS PUMPS, INC.* — S. A. Bunis, sales manager.

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pipe & fittings in stock...

Stainless steel piping for process installations, like the one pictured in Mogen David Wine Company's modern Chicago plant, can be readily supplied from our warehouse stock.

We maintain a large inventory of light-wall, standard, and extra-heavy stainless pipe in a variety of sizes and analyses—plus threaded and welding fittings, and valves.

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Maintain Proper Boiler Water Concentrations –

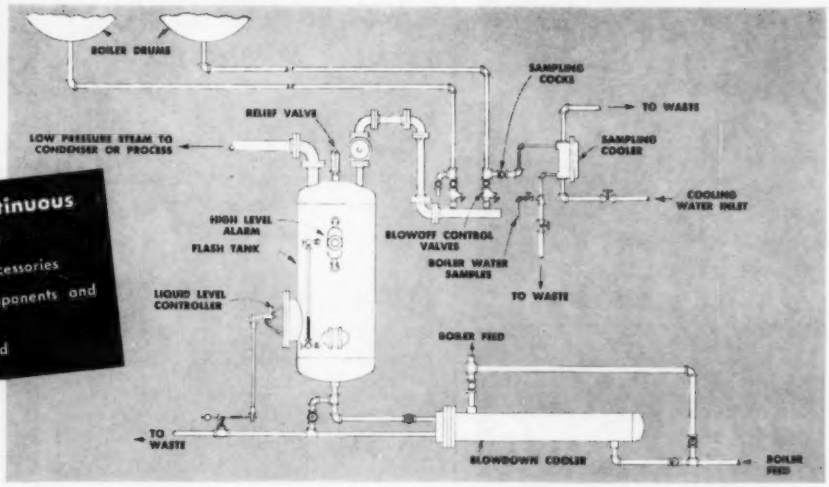
FOR ECONOMICAL BOILER OPERATION

Standard WHITLOCK Continuous Blowdown System

ECONOMICAL: standard low cost accessories

COMPLETE: with all operating components and controls carefully selected

AUTOMATIC: no attendance required



This Continuous Blowdown System automatically provides effective, low-cost boiler protection. Ask us to recommend a unit engineered for your plant.

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In Canada: Darling Brothers, Ltd., Montreal

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

Type S Condensate Pump
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Type ECR Condensate Pump
Type VV Vacuum Pump
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choose from a complete line of SARCO CONDENSATE and VACUUM PUMPS

SARCO CONDENSATE PUMPS discharge to boilers fast . . . give quiet, dependable operation . . . are constructed of finest materials . . . engineered for quick, easy installation to meet a variety of conditions . . . have steel or cast iron receivers and close coupled or flexible coupled motors.

SARCO VACUUM PUMPS have a reputation for quality based on a quarter century of experience and development . . . feature jet vacuum-producing unit—highly efficient in producing high vacuums and maintaining full rated water capacities . . . have flexible coupled motors and cast iron receivers.

WHAT ARE YOUR PUMP NEEDS? Make use of Sarco's wide and specialized experience in heating problems involving fluid movements. For information on Sarco condensate and vacuum pumps, all guaranteed for one full year, contact your Sarco sales representative, district office, or distributor; or write:

2362

SARCO

SARCO COMPANY, INC.
AN AFFILIATE OF SARCOTHERM CONTROLS, INC.
635 MADISON AVENUE, NEW YORK 22, N.Y.
PLANT: BETHLEHEM, PA.

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WITH MIRACLE SURFACE ANCHORS

Use Miracle Surface Anchors, bonded with Miracle Anchor Adhesives, to provide firm support for block, board, or blanket type insulation. Eliminates drilling and welding. You save man hours, cut costs way down.

Use Spindle Anchors for bonding fibrous glass batts, mineral wool to ducts, walls, ceilings. Lock washer holds insulation firmly in place.

Use Pronged Anchors for bonding block insulation such as cellular glass. Pronged Anchors are set between rows of blocks and then prongs are bent over.

FREE

Valuable, informative engineers and architects bulletins giving details and complete specification data. Yours on request.

MIRACLE SURFACE ANCHORS

are manufactured by

DEVICES • Division of **MIRACLE ADHESIVES CORP.**

250 Pettit Avenue
Bellmore, Long Island, New York

Large industrial panel filter installation.

NOW — tailor air filters to job requirements - economically!

A *new concept* in air purification, MICROMAT offers not one but *nine* separate filter media, each with specific capabilities. Used singly or in combination, there is a low-cost MICROMAT medium to meet virtually *any* set of specifications for efficiency and air flow. Thus the MICROMAT System, with a *choice* of media, provides the means of tailoring air filtration to your exact requirements.

MICROMATIC Roll Filter Machine — automatic, semi-auto., or manual operation

Efficiency Range — 5% to 85%

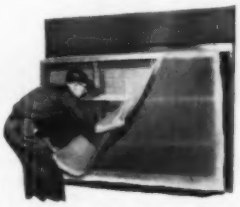
MICROMAT Replaceable Media are made from various types of non-woven synthetic fibers. Their natural filtering properties eliminate any need for viscous coating, yet MICROMAT media efficiencies range from 5% to 85% (using Discoloration Test procedures).

Cut Maintenance Costs

MICROMAT filters are easy to maintain . . . and normally afford worthwhile savings in handling, changing, and storage space when compared to permanent, washable filters and other replaceable types. Versatile in use, MICROMAT media are readily adaptable to panel (frame), blanket, or roll machine installation.

MICROMAT Outperforms Conventional Filters

Present users have found that, at any given air velocity, the right MICROMAT medium will outperform conventional filters and deliver cleaner air at lower overall cost.



BLANKET Filtration eliminates frames, increases capacity 12-15%.

(Where a washable, permanent filter is required, Microtron Corp. offers new MICROFOAM, a superior, acid and base resistant, plastic foam material with wide range of efficiencies and high dirt-loading characteristics.)

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Comes in 7 indexed sections covering time-labor costs in Air Conditioning, Plumbing, Heating Equipment, Fittings, Valves, Pipe, Pumps, Misc. (Insulation, Water Meters, Tanks, etc.)

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WHO'S WHAT

Continued

▸ *PEABODY ENGINEERING CORP.* — John Dunn, manager of marketing and technical services.

▸ *SCHAEVITZ ENGINEERING* — Burton F. Drill, director of marketing.

▸ *PORTER-CABLE MACHINE CO.* — Francis H. Gerlach, vice president of engineering.

▸ *SOLAR AIRCRAFT CO.* — W. D. Bryson, vice president, engineering and production.

▸ *THE NORTH AMERICAN MOGUL PRODUCTS CO.* — Arthur W. Pugsley, chairman of the board; C. Carlisle Tippit, president and treasurer; and R. H. Mohrman, executive vice president.

▸ *COOPER ALLOY CORP.* — Herbert J. Cooper, president and chief executive officer.

ROBVON BACKING RINGS

APPROVED FOR WELDING PIPE, VALVES, AND FITTING JOINTS

ROBVON TYPE "CCC" BACKING RINGS

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EXCLUSIVE WITH ROBVON

Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB automatically sets root gap. ROBVON rings are beveled to assure non-restricted fluid flow. Available in Carbon Steel, Wrought Iron, Chrome Alloys, Stainless Steel and Aluminum.

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SIMPLE—4-step water treatment IMPROVES Air Conditioning

End scale, slime and corrosion troubles in air conditioning water with Oakite Airefiner No. 52. All it takes is a ten-minute daily check up by one man. This way you maintain high cooling efficiency and you reduce out-of-service time, too.

How? With a simple four step program. (1) Charge water initially with Oakite Airefiner No. 52. (2) Test water daily. (3) Add upkeep when necessary. (4) Drain system and replace with new, charged water on a periodic basis.

That's all there is to it. Airefiner No. 52 checks slime and algae growth, prevents scale build-up and minimizes corrosion. It leaves tubes clean for efficient heat exchange. It's safe. It's inexpensive.

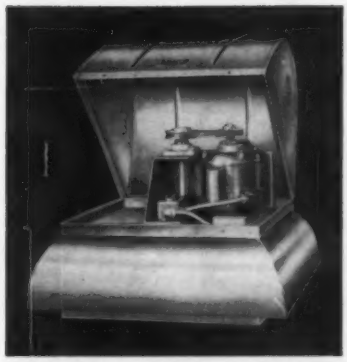
For explanatory drawings and full details on this time and trouble saving method, ask your local Oakite Technical Service Representative, or write Oakite Products, Inc., 51A Rector Street, New York 6, N. Y.

OAKITE

specialized
WATER TREATING
materials

In our 52nd year

Technical Service Representatives in Principal Cities of U. S. and Canada



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AIR HANDLING EQUIPMENT

ROOF VENTILATORS

- THIRTEEN SIZES
- SELF CONTAINED
- QUIET OPERATING

ALADDIN Type V Roof Ventilators are available in a complete range of sizes... direct and belt driven. Units can be furnished in both curb mounted or extended base types. Ruggedly built, the type V units have been designed for those installations where positive year around powered ventilation is required, and when properly installed, will give years of efficient trouble free service.

Write for complete data

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

MERCURY-TO-MERCURY SWITCH
requires no service—contacts never pit, burn or corrode.
PERMANENT ALNICO MAGNET
links water level with electrical controls; prevents failure of mechanical linkages.
CORROSION-RESISTANT FLOAT
is made of 304 Stainless Steel for long, trouble-free service. Can also be made of special materials for extreme local conditions.
NO-SCALE FLOAT CHAMBER LINER
"flexes" off scale; prevents float "sticking".

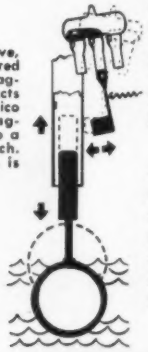
Here's "Low Maintenance"

BOILER SAFETY

MAGNETROL

BOILER WATER LEVEL CONTROLS

"Blow-down" the float chamber once-a-shift; inspect the switches once a month—that's all you have to do to keep a Magnetrol in tip-top *safe shape.* It's made that way. The secret is all in the simple magnetic operating principle *as pioneered and perfected by Magnetrol.*



A magnetic sleeve, raised and lowered within a nonmagnetic tube, attracts or repels an Alnico permanent magnet attached to a mercury switch. Basically, this is Magnetrol.

Standard Magnetrol Units are available for pressures to 600 psi and temperatures to 750°F., for single or multi-stage control with as many as three separate switching actions. Also special units for more extreme requirements. For full details, mail coupon.

MAGNETROL, Inc.

MAGNETROL, INC., 5322 Belmont Rd. Downers Grove, Ill.
Please send Catalog Section III with full information about Magnetrol Boiler Water Level Controls. 10

Name_____

Company_____

Address_____

City_____ Zone____ State_____

WE HEAR THAT . . .

▸ Joseph A. Cutler, former president and general manager of the *JOHNSON SERVICE CO.*, has been elevated to chairman of the board. He is succeeded as president by Richard J. Murphy who has held the office of executive vice president and treasurer.

▸ An agreement between *BABCOCK & WILCOX CO.* and a Japanese company will allow the Japanese firm to manufacture and sell B&W's entire line of refractories. The pact covers a 10 year period, dating from January 1961.

▸ Joseph L. Maloney has been re-elected president of the *CLAY FLUE LINING INSTITUTE.* A. R. Thorson was re-elected secretary and Philip E. Kopp was re-elected treasurer.

▸ *MCQUAY, INC.* has begun construction on its third plant. The structure is being built in Visalia, Calif.

▸ *THOR POWER TOOL CO. OF AMERICA* has bought sole control of the Italian firm, *FIAP,* located in Turin. Included in the transaction was the acquisition of a substantial minority interest in a Spanish company, *FIAP ESPANOLA,* in Barcelona.

▸ *GLAUBER VALVE CO.* has nearly completed a 6000 sq ft addition to its foundry. Production is expected to double with the enlarged quarters.

▸ *BRYANT MANUFACTURING CO.* has opened a wholesale branch in Pittsburgh.

▸ Three manufacturing companies have been elected into the *GAS APPLIANCE MANUFACTURERS ASSOCIATION.* They are the *THERMOELECTRIC PRODUCTS GROUP OF MINNESOTA MINING AND MANUFACTURING CO.; NEW YORKER STEEL BOILER CO., INC.;* and *H. A. THRUSH AND CO.*

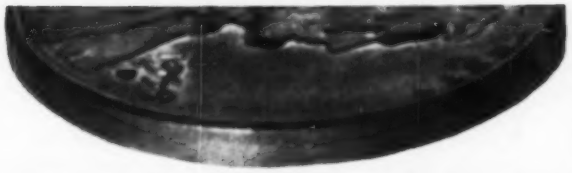
▸ Charles R. McConner, vice president of sales of the *CLARAGE FAN CO.,* will begin partial retirement this month after more than 40 years of service. Following a few months leave of absence, he will return to the firm serving on special assignments. His successor as general sales manager will be Alfred L. Otis.

▸ *BELL & GOSSETT CO.* has completed construction on a new building in Morton Grove, Ill. containing 32,000 sq ft of manufacturing area. Adjacent to the building is 11,000 sq ft of shipping area. Total plant area is now almost 450,000 sq ft.

WE CAN PUT THIS–

INTO THIS–

SAVING YOU TIME AND MONEY!



MID-CONTINENT SUPPLIES AND PACKAGES QUALITY FASTENERS ELECTRONICALLY

WITH **fasten-PAK**

PACKAGING SERVICE

KD PRODUCTS, INSTALLATION MANUFACTURERS

Here is the ideal method to have fasteners packaged economically, saving time and errors. Get your fasteners packaged and supplied with a one-stop service.

Here's what fasten-PAK does for you! fasten-PAK's automated packaging is ideal for use in KD or installation type products. This modern way of packaging eliminates chance of error over hand count or weight methods. In one operation Mid-Continent supplies fasteners to you, then with fasten-PAK packages your fasteners by counting, filling, sealing, and prints copy identifying any of the parts contained in each package. The bags can be supplied in either translucent or kraft opaque materials. In addition, when you buy your fasteners from Mid-Continent your savings are **doubled.** Why not investigate this unique form of packaging fasteners . . . **you'll be glad you did!**

for information contact:

MID-CONTINENT SCREW PRODUCTS CO.

5844 NO. BROADWAY Dept. HPAC-3 CHICAGO 40, ILLINOIS

usAIRco

40 years experience in air conditioning

RUGGED CONSTRUCTION

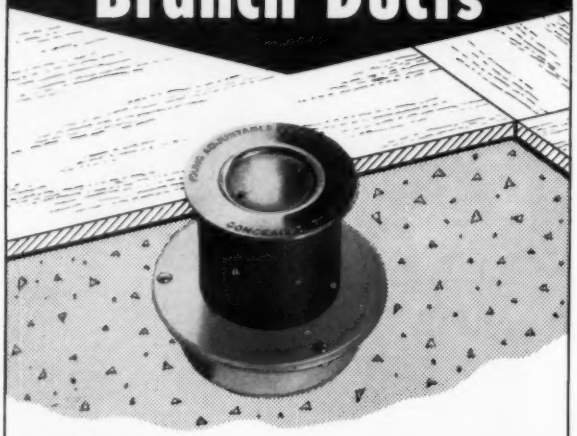
Built for Efficient Performance, Long Life, Trouble-Free Operation

WRITE FOR
PRODUCT BULLETINS
74 and 83B

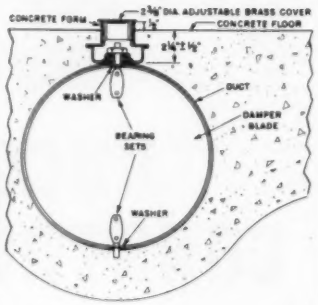
United States Air Conditioning Corporation
Delaware, Ohio

For a better balanced Perimeter Heating and Cooling System - *install*

YOUNG Floor Line Adjustable Cover Regulators in Branch Ducts



Adjustable Brass Cover screws down flush with floor after form is removed.



The Young No. 330 Regulator, installed in a branch duct, gives *accurate* control of the volume of air to the register.

This is the *sure way* of controlling the required volume of air for individual rooms.

Only 2-3/8" in diameter, the adjustable cover plate fits flush with the floor. Model No. 330 is for installations with up to 2" of concrete above the duct. Other models are available for up to 12" of concrete above the duct.

Write for complete catalog or consult Sweet's Architectural File or the Engineer's Product File.

YR

YOUNG REGULATOR COMPANY

20910 Miles Parkway, Cleveland 28, Ohio

WE HEAR THAT

Continued

▸ The new president of the *ILLINOIS MANUFACTURERS ASSOCIATION* is H. C. Mueller, president of *THE POWERS REGULATOR CO.*, Skokie, Ill.

▸ *BERKO ELECTRIC MANUFACTURING CORP.* has opened a new plant in Jamaica, N.Y. The plant houses both manufacturing and executive offices.

▸ The *NATIONAL FUELOIL COUNCIL* and the *OIL HEAT INSTITUTE OF AMERICA*, respectively, on January 25 and 26, at board of director meetings of each organization in New York, voted unanimous approval of the merger of these organizations into a new national association which will promote fuel oil and oil heating equipment.

▸ *SPEAKMAN CO.*, wholesale distributor of heating and industrial supplies, will open a new branch office in Dover, Del.

▸ *ULTRASONIC SYSTEMS INC.* has moved into new quarters at 2255 Carmelina Ave., West Los Angeles.

▸ *IRON FIREMAN MANUFACTURING CO.* has expanded its operations in the package generator field by offering its product backed by a single corporate responsibility.

▸ *EDWIN L. WIEGAND CO.* will market the line of electric counterflow heating units manufactured and formerly sold by *ELECTREND PRODUCTS CORP.* The heaters will retain the Electrend name.

▸ *THE POWERS REGULATOR CO.* has consummated an agreement with Mosler Research Products, Inc. to market Mosler's line of ultra sensitive electronic security devices. These will be used in integrated climate control and security systems.

▸ *IMPERIAL-EASTMAN CORP. LTD.* will begin construction of a 23,000 sq ft plant and office building in Barrie, Ontario, Canada. Scheduled for completion by September, the new facility is expected to represent an investment reaching nearly $750,000.

▸ *RELIANCE INSTRUMENT DIV. OF ELECTRO-MECH CORP.* has moved into its new plant in Norwood, N.J. The facility is the new home of both Reliance and its parent firm.

ELECTRIC
HOT WATER HEAT
TO 2,500,000 B.T.U. OUTPUT

PRECISION
ELECTRIC HOT WATER HEATING BOILER

COMPLETE UNIT READY FOR INSTALLATION
with circulation hot water system and water chiller for year-round air conditioning.

CONVERSION EASILY ACCOMPLISHED
where other type fuels now used. Suited for home, churches, motels, apartments, hotels, hospitals, commercial buildings, swimming pools, snow melting and domestic hot water for large users. Temperature range — 60 to 250 degrees. Equipped with Sequence and Proportional Controls when desired.

- **Every unit tested and inspected 40,948 to 2,500,000 B.T.U. Output.**
- **All Boilers meet the requirements of the ASME Boiler and Pressure Vessel Code. Natl. Board approved.**

No chimney! No odors! No flame! No ducts! No noise!

Write for complete specifications and prices

PRECISION parts corporation
400-HPA NORTH FIRST STREET
NASHVILLE 7, TENNESSEE

Is CFM enough of a criterion for Ventilator Specifications?

Yes, if you have unlimited funds and your only concern is moving a given amount of air in the immediate future.

Unfortunately, most structures have to be built within a budget. So, it behooves designers to specify components which represent the best *value* for the money . . . and don't increase other expenses incidental with installation and use.

YOU CAN SAVE MONEY FOR YOURSELF AND YOUR CLIENT:

Cook ALL ALUMINUM VENTILATORS

. . . THE ONLY VENTILATOR WITH A 5 YEAR WARRANTY GIVES YOU PERFORMANCE PLUS

LESS ROOF LOAD
Important in large installations. All Aluminum construction reduces weight 40% under steel. This can save money on roof supporting members.

CUT INSTALLATION TIME
Time is money. Cook Ventilators are engineered for simple, efficient installation.

ELIMINATE SERVICE CALLS
Quality construction, superior design assure top performance, without tinkering and fiddling!

GUARANTEE SATISFACTION
Corrosion resistant Aluminum gives years of service without weathering. Maintenance is reduced to minimum.

. . . AND the Cook line is complete—meets any ventilating requirement. For complete specs send for our 1961 Catalog. Also see "Sweet's Architectural", Classification 20c.

Name & Title_____

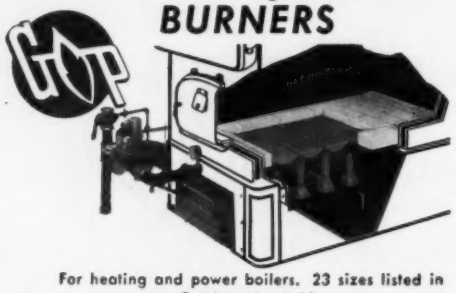
Company_____

Address_____

City_____ Zone_____ State_____

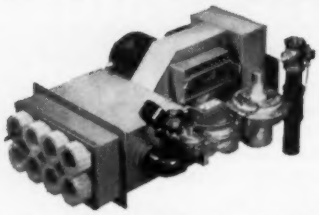
Cook ALL ALUMINUM VENTILATORS
THE LOREN COOK COMPANY
BEREA, OHIO MEMBER AMCA

"Planned Performance"*
BURNERS



For heating and power boilers. 23 sizes listed in Catalog No. A-10.

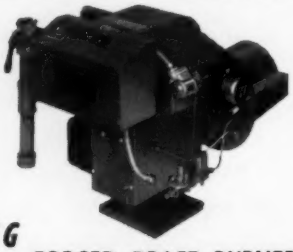
BLUE LINE UPSHOT ATMOSPHERIC GAS BURNER



Fully automatic, packaged assembly. Sizes listed to 28 million BTU/HR in Catalog C-10

TURBO-FIRE POWER TYPE GAS BURNER

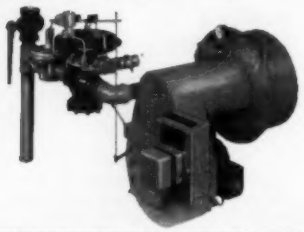
MODEL R
Capacities up to 2¼ million BTU/HR
Catalog E-61



TURBO-RING FORCED DRAFT BURNERS

Gas, oil, or combination Gas-Oil burner. No stack required on boilers equipped for pressure firing.

MODEL FGR
Capacities 1 to 9 million BTU/HR
Catalog E-51



* PLANNED — Factory assembled, pre-wired for "Bolt-in" installation.

* PERFORMANCE — Custom matched to individual boilers for quiet, efficient operation.

Gordon & Piatt also manufacturer of a complete line of domestic conversion burners plus large dual-fuel units. Write for literature and complete information.

Gordon & Piatt
P. O. Box 914
Winfield, Kansas

WE HEAR THAT

Continued

▸ *HUPP CORP.* has realigned its organization structure along group lines to effect closer liaison between the corporate staff and its operating divisions. Anthony J. De Fino and Robert N. Ward have been named group vice presidents.

▸ *BELL & GOSSETT CO.* has acquired the *CIRCUIT DEVELOPMENT CORP.*, Boulder, Colo., producers of electronic equipment.

▸ *JET-HEET INC.* has leased a 10,000 sq ft building in Englewood, N.J. in an expansion of its manufacturing operations. The plant will also be used for showroom and sales training purposes.

▸ Richard D. Madison, director of research of the *BUFFALO FORGE CO.*, has retired after 41 years of service.

▸ *DANIEL T. WEBSTER, JR.* has joined the staff of *SEELYE STEVENSON VALUE & KNECHT*, as consultant.

▸ *IMC MAGNETICS CORP.* will market heat exchangers made by the *AERO SUPPLY MANUFACTURING CO., INC.*, as part of an extension of a previous agreement to market fan cooling equipment and blowers.

▸ *MANNING, MAXWELL & MOORE, INC.* will build a new valve manufacturing plant in Alexandria, La. The facility will be a one-story 125,000 sq ft building located on a 100 acre site. Completion of the project is expected to be in the fall of this year.

▸ *GENERAL CONTROLS CO.* has moved its Denver, Colo. offices to 2323 W. 2nd Ave. in Denver.

▸ An expansion of approximately 3500 sq ft will be made at the *SONOCO PRODUCTS CO.* plant in Hartsville, S.C. The addition, due for completion in early spring, is being built at a cost of $150,000.

▸ The merger of *JACK & HEINTZ, INC.* into *SIEGLER CORP.* is now completed. Jack & Heintz will be operated as a division of Siegler.

▸ The *NATIONAL CYLINDER GAS DIV., CHEMETRON CORP.* has recently completed construction of a one-story building in Lynwood, Calif. that will house both office and warehouse facilities. The new facility will be the firm's Los Angeles headquarters.

$50 Million Dollar

NEW TERMINAL AND AIRFIELD FACILITIES

Los Angeles International Airport

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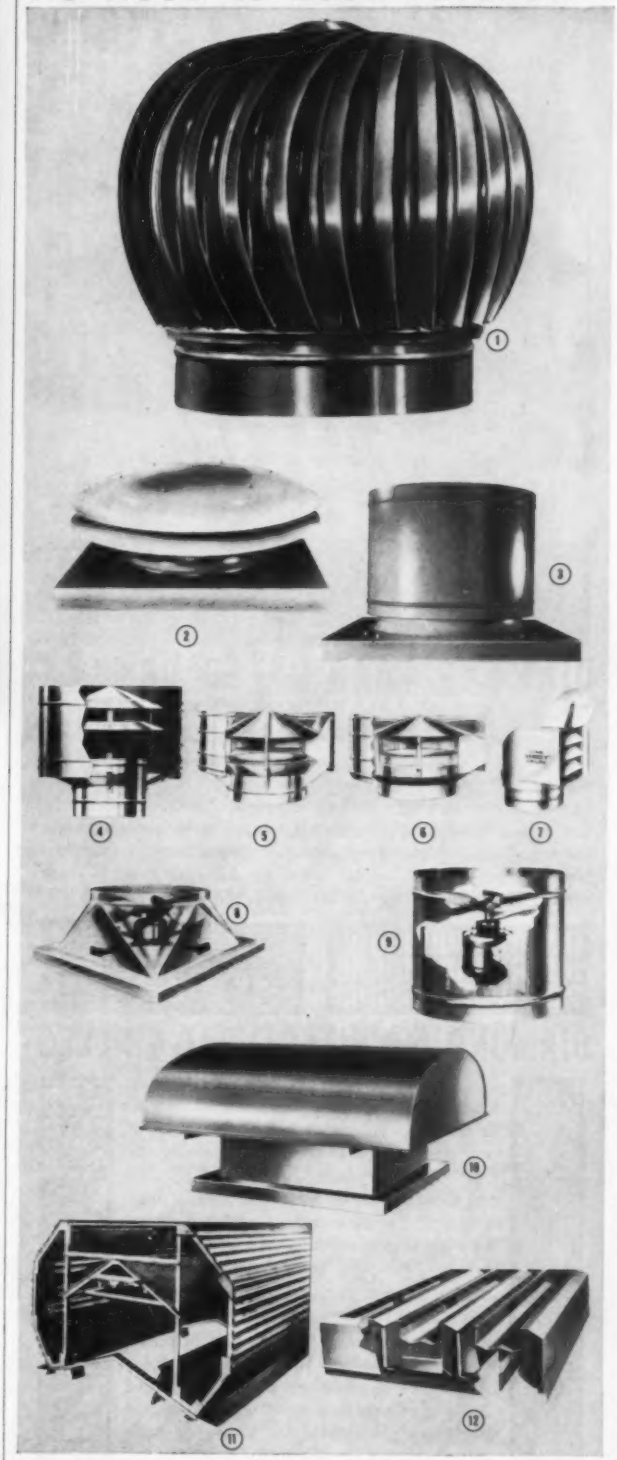

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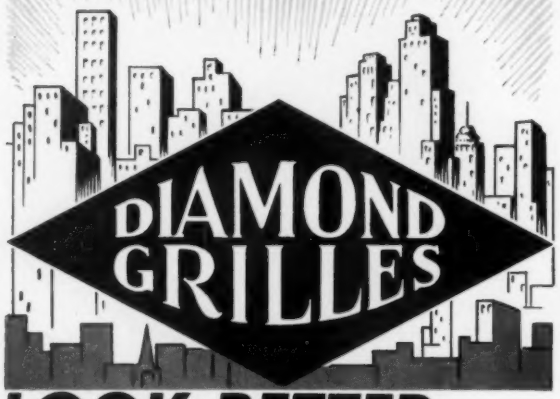

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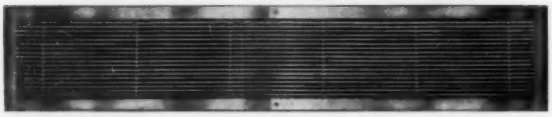

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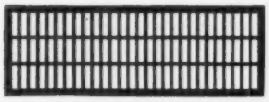

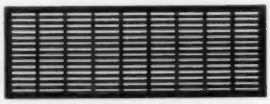

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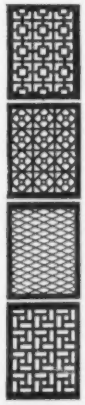

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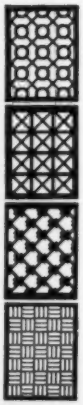

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WE HEAR THAT

Continued

▸ *RAYTHEON CO.* has acquired the stock of Trans-Sil Corp., Englewood, N.J., manufacturers of silicon rectifiers.

▸ *STRONG, CARLISLE & HAMMOND, DIV. OF WHITE SEWING MACHINE CO.*, has purchased the manufacturing and sales rights of certain products from *CRANE CO.* The products include iron separators, brass expansion joints, and sediment separators (T-type strainers).

▸ *MULTI-AMP ELECTRONIC CORP.* is building a new plant and administrative office building on a two-acre site in Cranford, N.J. The facility will have a production capacity eight times the present plant and is expected to be ready for occupancy by mid-spring.

▸ Henry L. Burghoff has been appointed director of research and development for *CHASE BRASS & COPPER CO.* Dr. Burghoff succeeds D. K. Crampton who is retiring after more than 44 years of service.

▸ *LAWSON MANUFACTURING CO.* has moved its entire facilities from New Kensington, Pa. to Oakmont, Pa. The move was made in an effort to centralize the firm's water heater production.

▸ *GENERAL CONTROLS CO.* has established a scholarship at Stanford University. The scholarship was established in the name of William R. Ray, one of the firm's founders. Additional information is available from the office of admissions, Stanford University, Palo Alto, Calif.

▸ Wilfred W. Aronwits, P.E., has joined the staff of the *J & G DAVERMAN CO.*, engineers, architects, and planners, Grand Rapids, Mich., and has been named chief of the firm's mechanical engineering department.

▸ Dr. Franklin B. Rote has been appointed director of research and development for *MUELLER BRASS CO.*

▸ Installation of new automatic equipment and the introduction of modern tooling and production methods have more than doubled the capacity of *MILWAUKEE VALVE CO., INC.*

▸ *LAU BLOWER CO.* has purchased the Meier Electric and Machine Co., Indianapolis, manufacturers of propeller blades. The acquired firm will operate as a division of the parent firm, with present personnel being retained.

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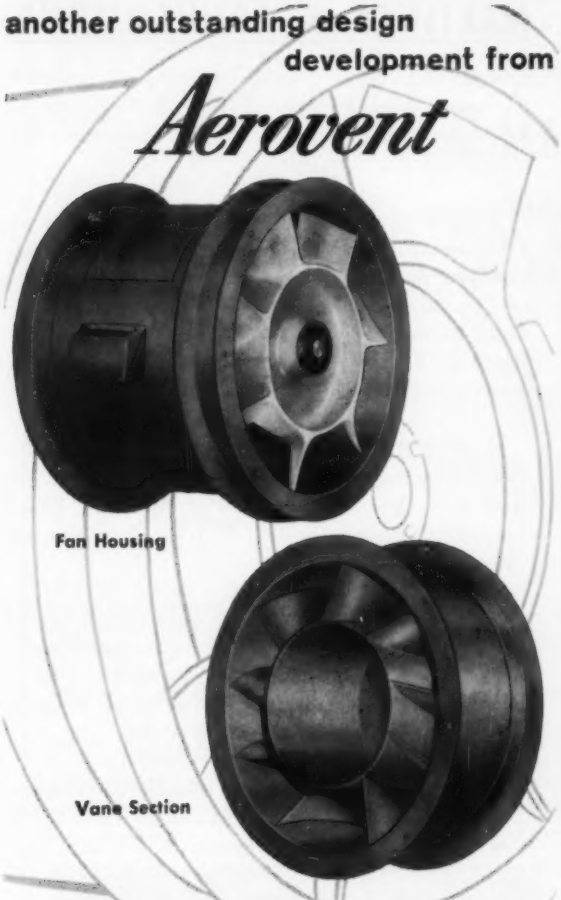

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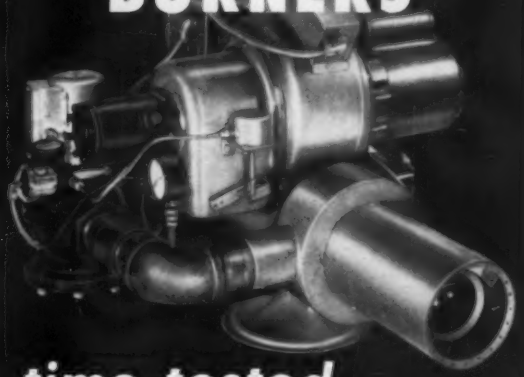

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MEETINGS & CONVENTIONS

MARCH 13-17 — *17th Annual Conference and* 1961 *Corrosion Show.* Statler Hilton Hotel, Buffalo, N.Y. Information: National Association of Corrosion Engineers, 1061 M & M Building, Houston.

MARCH 27-31 — *Third National Symposium on Temperature — Its Measurement and Control in Science and Industry.* Sponsored by American Institute of Physics, Instrument Society of America, and National Bureau of Standards. Columbus, Ohio. Information: W. R. Tilley, National Bureau of Standards, Washington, D.C.

MARCH 21-23 — *The 23rd Annual American Power Conference.* Sherman Hotel, Chicago. Information: Dr. Roland A. Budenholzer, director, American Power Conference, Illinois Institute of Technology, Chicago 16.

APRIL 10-21 — *American Welding Society's 42nd Annual Convention and Welding Exposition.* Convention at the Sheraton-Atlantic Hotel and the Show at the Coliseum, New York. Information: AWS Information Center, 33 W. 39th St., New York 18.

APRIL 23-27 — *Oil Heat Institute of America, 39th Annual Convention.* Statler-Hilton Hotel, Washington, D.C. Information: Francis J. Schuster, convention chairman, OHI, 500 Fifth Ave., New York 36.

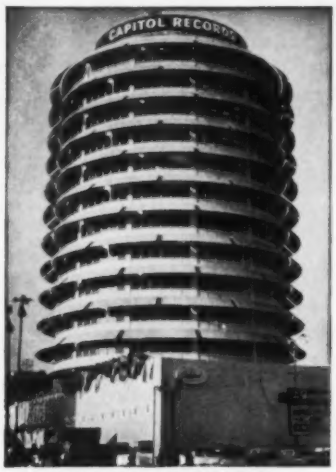
MAY 4-6 — *Consulting Engineers Council's Fifth Annual Board of Directors Meeting.* Executive House, Chicago. Information: CEC, 326 Reisch Bldg., Springfield, Ill.

MAY 9-12 — *Mechanical Contractors Association of America Annual Convention.* Fountainebleau Hotel, Miami. Information: MCAA, Suite 570, 45 Rockefeller Plaza, New York 20.

JUNE 4-9 — *Seminar on Electrical Precipitation.* The Pennsylvania State University, University Park, Pa. Information: Conference Center, The Pennsylvania State U., University Park, Pa.

JUNE 11-15 — *The 54th Annual Air Pollution Control Association Meeting.* Hotel Commodore, New York. Information: Sheldon W. Samuels, director of public information, New York State Air Pollution Control Board, 84 Holland Ave., Albany 8, N.Y.

JUNE 12-15 — *National District Heating Association, 52nd Annual Meeting.* Wentworth-by-the-Sea, Portsmouth, N.H. Information: John F. Collins, Jr., secretary-treasurer. NDHA, 827 N. Euclid Ave., Pittsburgh 6.



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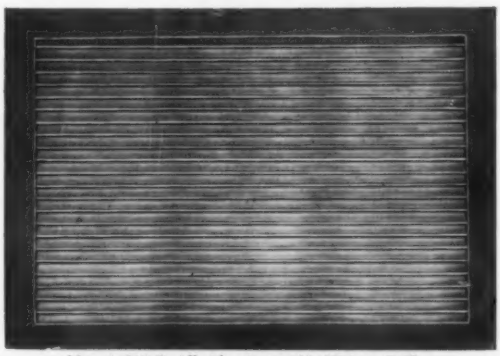

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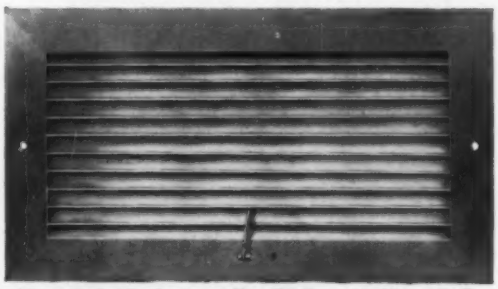

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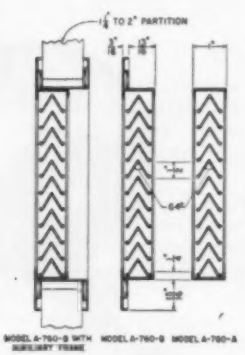

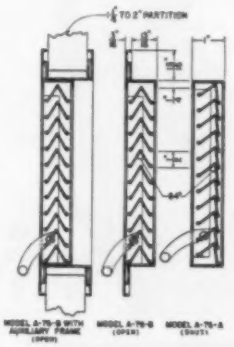

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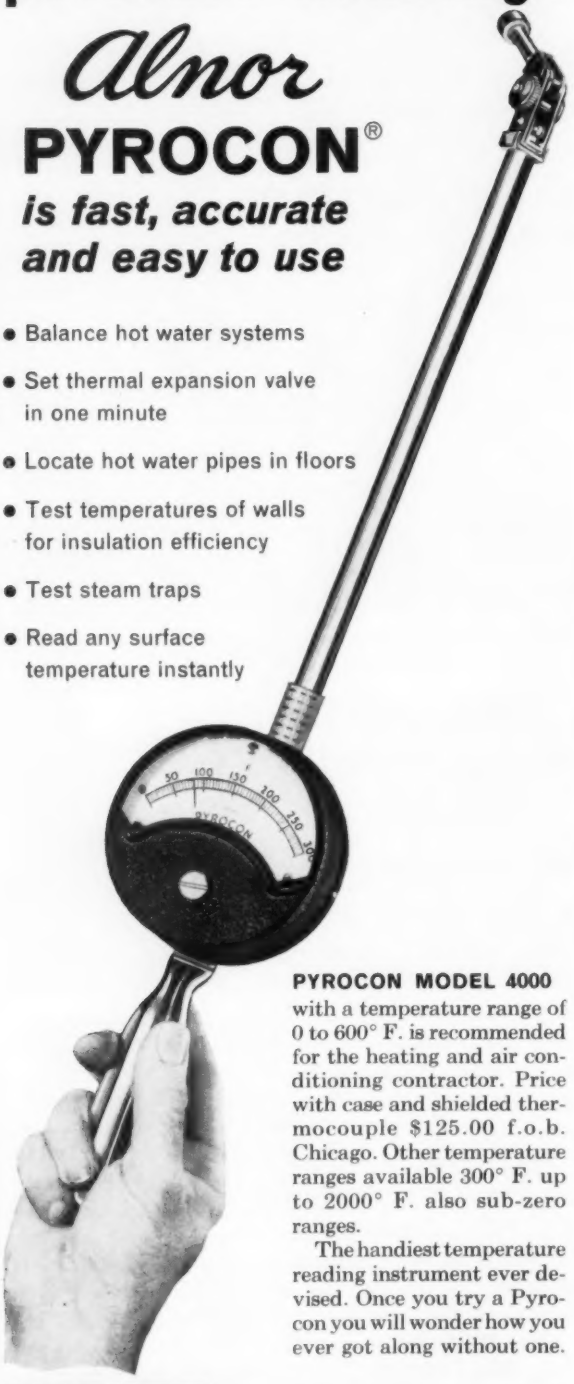

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MEETINGS & CONVENTIONS

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JUNE 12 — *Air Pollution Instrumentation Symposium*, in conjunction with the *JUNE* 12-16 *Annual Meeting of the Air Pollution Control Association*. Sponsored by ISA and APCA, Hotel Commodore, New York. Information: APCA, 4400 Fifth Ave., Pittsburgh 13.

WEEK OF JUNE 12 — *The Institute of Boiler and Radiator Manufacturers Annual Meeting*. Seaview Country Club, Absecon, N.J. Information: IBR, Room 408, 608 Fifth Ave., New York 20.

JUNE 25-30 — *American Society for Testing Materials Annual Meeting*. Chalfonte-Haddon Hotel, Atlantic City, N.J. Information, ASTM, 1916 Race St., Philadelphia 3.

JUNE 26-28 — *American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Annual Meeting*. Hilton Hotel, Denver, Colo. Information: ASHRAE, 234 Fifth Ave., New York 1.

SEPT. 27-*OCT.* 4 — *The Institute of Heating and Ventilating Engineers, International Conference on Heating, Ventilating and Air Conditioning*. London, England. Information: F. L. Rossetti, secretary, Conference Coordination and Management Committee, 49, Cadogan Sq., London, S.W.1.

NOV. 12-15 — *Air-Conditioning and Refrigeration Institute Annual Meeting*. The Homestead, Hot Springs, Va. Information: ARI, 1346 Connecticut Ave., N.W., Washington 6, D.C.

NOV. 13-16 — *National Warm Air Heating and Air Conditioning Association Annual Convention*. La Salle Hotel, Chicago. Information: NWAHACA, 640 Engineers Bldg., Cleveland 14.

NOV. 26-*DEC.* 1 — *The American Society of Mechanical Engineers Winter Annual Meeting*. Statler Hilton Hotel, New York. Information: L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18.

1962

FEB. 12-15 — *Air-Conditioning and Refrigeration Industry 12th Exposition*. Pan-Pacific Auditorium, Los Angeles. Information: George E. Mills, ARI Show Director, ARI, 1346 Connecticut Ave., N.W., Washington 6, D.C.

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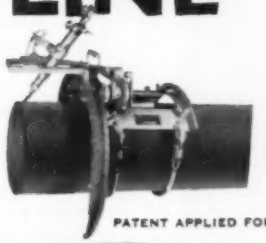

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Research Highlights of the National Bureau of Standards, Annual Report 1960, *Publication* 237 — Describes approximately 225 programs in 18 different fields of research and development including such topics as the recent change in the world standard meter. 189 pages. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price, 65 cents.

ASTM Specifications for Steel Piping Materials — A compilation of selected ASTM standards of steel pipe, tubing, and accessory materials. Covers pipe used to convey liquids, vapors, and gases at normal and elevated temperatures; still tubes for refinery service; heat exchanger and condenser tubes; and boiler, superheater, and economizer tubes. American Society for Testing Materials, 1916 Race St., Philadelphia 3. Price, $7.00.

Centrifugal Pumps: Selection, Operation, and Maintenance — Includes information covering the entire field of centrifugal pumps, their drivers, controls, and other appurtenances. Describes and illustrates all types of pumps, including vertical, self-priming, and regenerative pumps. Discusses and specifies pumps for every area of industrial and utility service. Written by Igor J. Karassik, consulting engineer, and the late Roy Carter, public works consultant. 488 pages. Dodge Books, F. W. Dodge Corp., 119 W. 40th St., New York 18. Price, $15.75.

Recommended Practices for Gas Shielded-Arc Welding of Aluminum and Aluminum Alloy Pipe — This 40 page booklet (prepared by the American Welding Society Committee on Piping and Tubing) covers all phases of aluminum pipe welding, from processes and machine settings to welding techniques and heat treatment. American Welding Society, 33 W. 39th St., New York 18. Price, $2.00.

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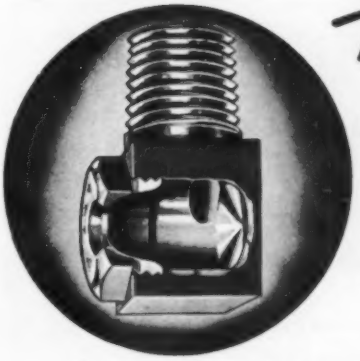

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USSR Literature on Air Pollution and Related Occupational Diseases, Volume 4 — Among topics covered are Russian research, development, and progress in the use of the "Sanitary Clearance Zones" — belts of trees, shrubs, and other vegetation between waste-discharging industrial establishments and residential areas, to help purify atmospheric air. 290 pages. Office of Technical Services, Business and Defense Services Administration, U.S. Department of Commerce, Washington 25, D.C. Price, $4.00.

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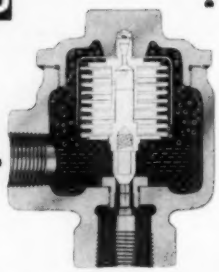

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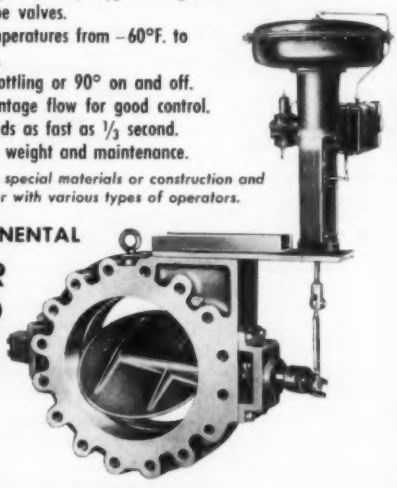

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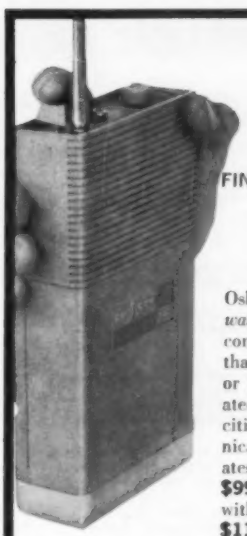

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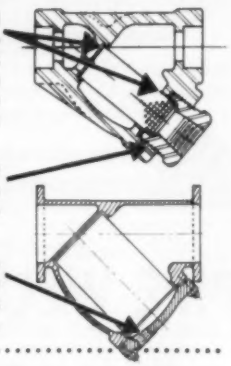

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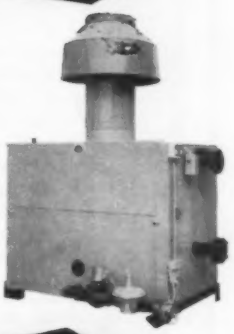

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Precision Measurement and Calibration, NBS Handbook 77 — Three volumes offered: *Vol.* 1, *Electricity and Electronics*, 845 pages, $6.00; *Vol.* 2, *Heat and Mechanics*, 965 pages, $6.75; and *Vol.* 3, *Optics, Metrology, and Radiation*, 1,025 pages, $7.00. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

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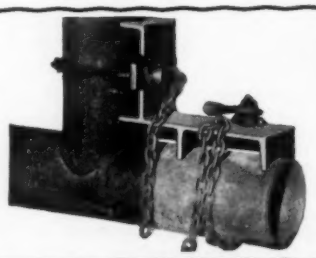

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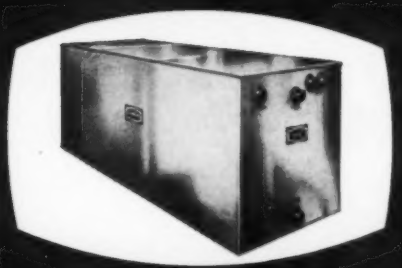

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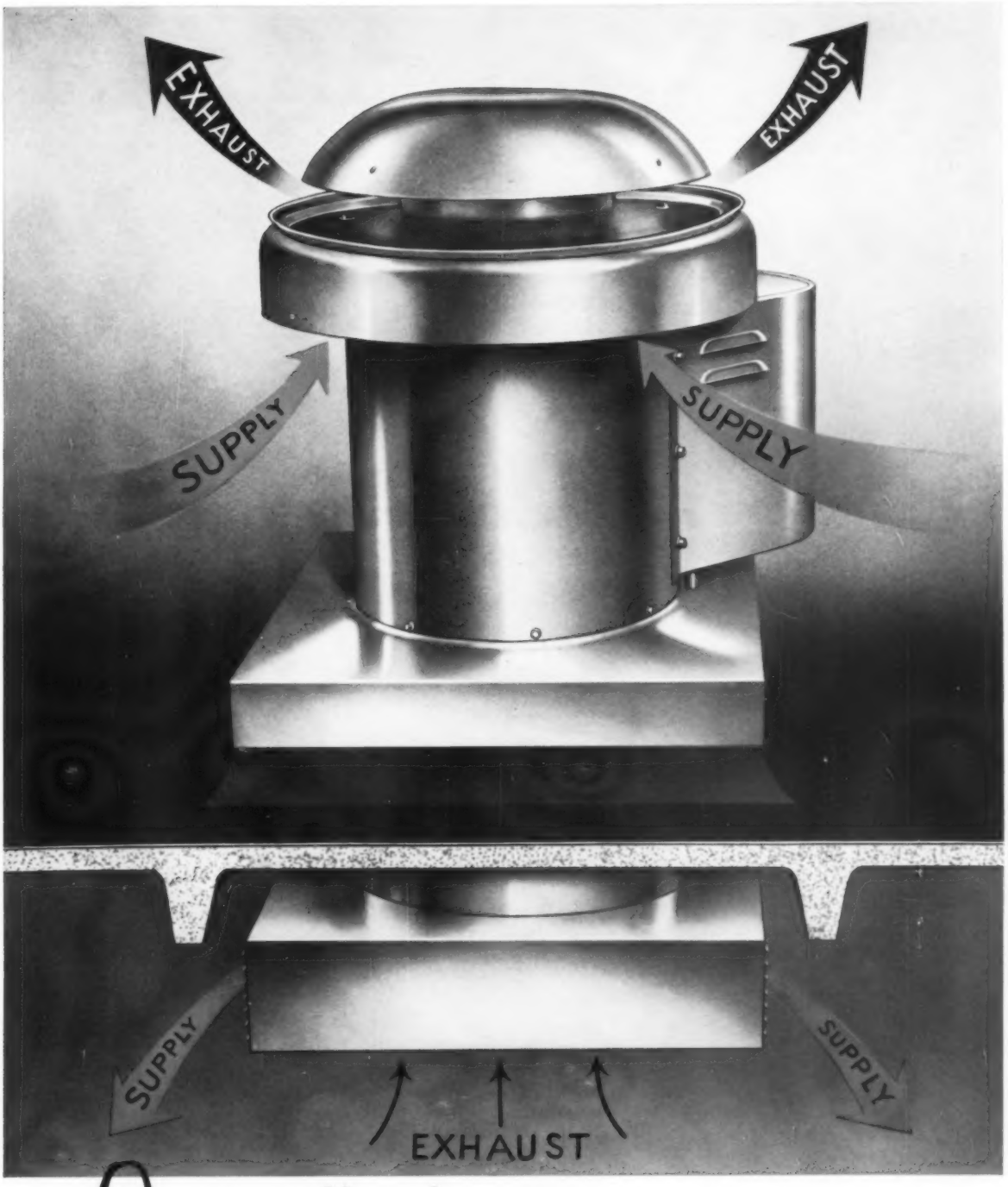

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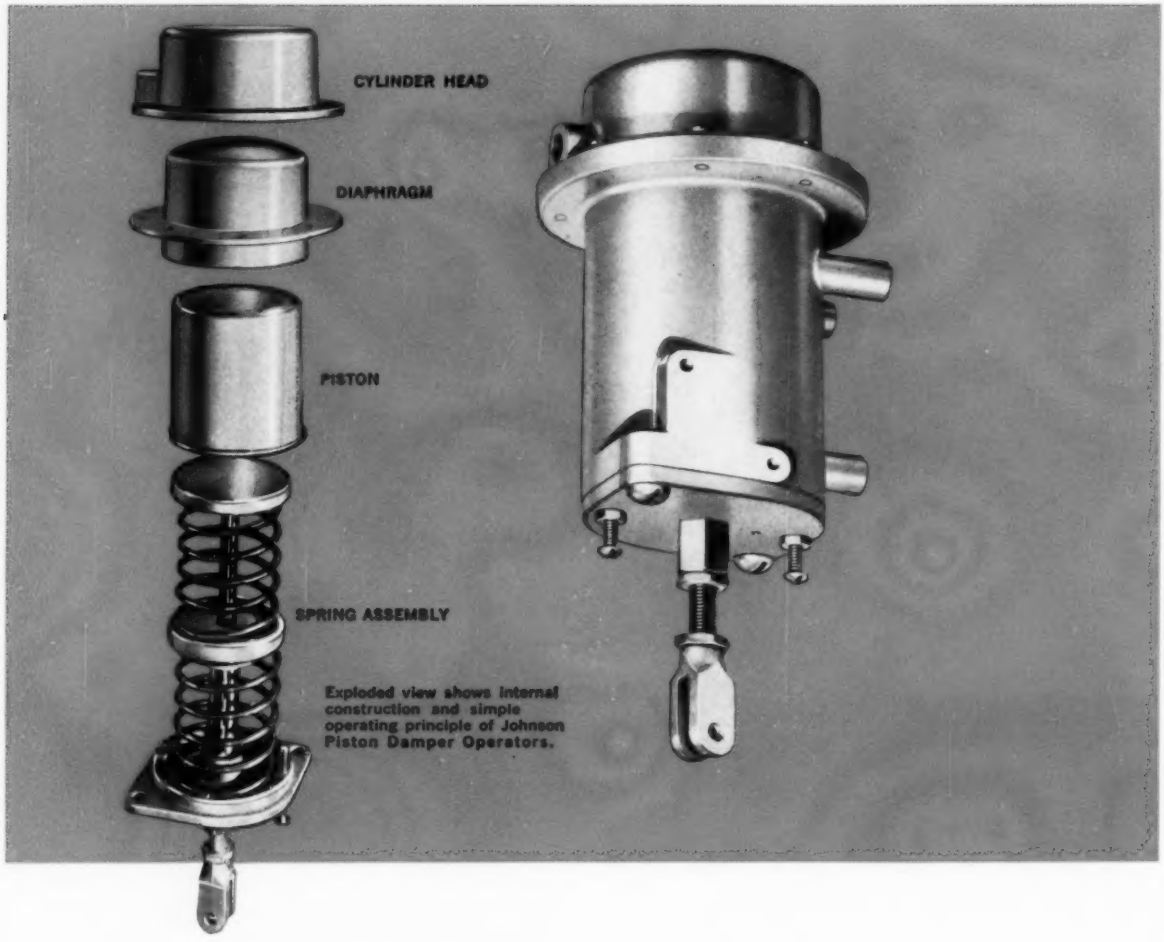
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